

**Increasing Direct Marketing for Fruit Farmers by Connecting Producer to Producer
through Research and Development of a Value-Added Product**

Final Report
Federal-State Marketing Improvement Program

Grant Agreement No. 12-25-G-0307

Submitted to Jim Anderson, Program Director
Missouri Department of Agriculture

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INTRODUCTION

Missouri fruit growers rely on the fresh market to sell their product. Currently growers are struggling to remain competitive in that market. If the fresh market is oversupplied, most growers have no alternative market for the surplus. Some growers lose 30 percent of their crop due to surplus and damage. As a result, a significant portion of the harvested crop is lost with no economic benefit to the grower.

The purpose of this proposal was to connect Missouri fruit growers who have surplus fruit with Missouri wineries interested in making a new value-added product, fruit brandy, which can then be sold as fruit spirits or used to make fruit ports and fruit infusions. A pilot distillery was established at the Missouri State Fruit Experiment Station, which allowed researchers to distill various types of fruit and evaluate the fruit brandies before recommending them for commercial production. The proposal also focused on assessing the financial infrastructure necessary to produce fruit brandy including an evaluation of the Missouri market for products such as specialty brandies and fruit ports.

GOALS, OBJECTIVES, AND ACTIVITIES

Goal 1: The State of Missouri will have implemented a program that connects producer to producer by connecting fruit growers with surplus fruit to wineries interested in making fruit brandy.

Objective 1: Conduct a survey of fruit growers and wineries to identify willing participants in direct marketing surplus fruit to be used for making fruit brandy products.

Activities completed:

- (a.) Two surveys have been written, one to the Fruit Producer and the other to the Vintner.
- (b.) The surveys have been mailed and collected.
- (c.) Dr. Hoon Kim, statistician consultant, has disseminated the information and presented the results to the State Fruit Experiment Station.
- (d.) Missouri State Fruit Experiment station continues to serve as a facilitator throughout the process.

Objective 2: Publish the information from the survey and make it available to both the fruit and wine industries of Missouri.

Activities completed:

- (a.) The report has been completed. The report was mailed to the fruit growers and vintners the week of September 4, 2001.
- (b.) The complete report written by Patrick Byers, Murli Dharmadhikari, and Hoon Kim is found in ATTACHMENT A.

Goal 2: An Assessment of the business and financial infrastructure necessary to produce fruit brandy products in Missouri will have been conducted and an evaluation of market for brandy will have been established.

Objective 1: Develop and administer the assessment of infrastructure and evaluation of the fruit brandy market in Missouri.

Activities completed:

- (a.) The interview with dealer/wholesalers of brandy and other liquors has been completed and the data has been disseminated.

The report consists of two parts. Part one deals with a national trend in alcohol consumption and the part two gives an assessment of the market for the brandy/brandy products made from Missouri fruit.

Objective 2: Publish the information from the assessment and evaluation of the market and make it available to the fruit and wine industries of Missouri.

Activities completed:

- (a.) The report was published and made available to all fruit growers and wineries in the state of Missouri.
- (b.) The complete report written by Arbindra Rimal is found in ATTACHEMENT B.

Goal 3: The State of Missouri will have developed a new value-added product, fruit brandy, using surplus fruit from Missouri fruit farmers.

Objective 1: Assess successful distillery operations in other states at the research and commercial level and apply the information gained to this project.

Activities Completed:

- (a.) A trip to Stuttgart, Germany was taken May 17 – 25, 2001 for the INTERVITIS Expo to investigate European fruit distillation. The Expo was followed by a private tour of German distilleries and study with Dr. Klaus Hagmann, consultant for the German/Austrian distillation industry. A trip to the New York state and Michigan state distillation industries was taken August 16 – 24, 2001. Many distillers were visited to gain information about the commercial production of fruit brandies and brandy products in the United States. Much information was gained and contacts made from each of these trips that will benefit and accelerate the product development in Missouri.
- (b.) This activity is a continual process. Kimberly Rey continues to research methods and talk with other distillers of fruit brandy. She attended a presentation on February 6, 2001 by Dr. Kris Berglund of Michigan State University on the Distillation of Fruit.

Objective 2: Purchase, install, and test equipment required to produce and evaluate fruit brandy.

Activities Completed:

- (a.) The distillery has been constructed. The refrigeration units, fermenters and cleaning systems have been purchased and are in operation.
- (b.) Christian Carl Still Company out of Germany installed the still on March 19, 2001.

Objective 3: Set up a pilot distillery and produce fruit brandy, which can then be used to make many other fruit products such as fruit ports and fruit infusions.

Activities Completed:

- (a.) Fruit from 2000 harvest was donated by the State Fruit Experiment station, and was frozen until the still was installed. March 19, 2001 brandy production began using the frozen fruit. The product was evaluated for quality by sensory only. The product is aging and will be evaluated using gas chromatography. Donated fresh fruit from the 2001 peach and apple harvest was distilled through October 23, 2001.
- (b.) The brandies were evaluated using both sensory and analytical means.
- (c.) A complete report written by Kimberly Rey is found in ATTACHMENT C.

ATTACHMENT A

Goal 1 Report

To members of Fruit and Wine industry

Report on Fruit Industry survey
M.R.Dharmadhikari
Enology Advisor
Department of Fruit Science
SMSU Mtn. Grove

A survey of Fruit and Wine Industry members was conducted in the spring of 2001. The aim of the survey was to evaluate the interest among fruit growers and wine makers in producing a value added products from surplus apples and peaches. Dr. Hoon Kim of the Department of Mathematics SMSU assisted in designing the survey and performing the statistical analysis. The summary of the report is included.

Comments

Important findings of the **Winemakers** survey along with comments are presented here.

Based on the winemaker's response it seems that nearly half of them, (8 Out of 19) are not interested in developing and marketing value added products from surplus fruit. Main reasons for their lack of interest include lack of investment capital and the professional expertise.

Missouri wine industry is vary diverse in terms of size and capital investment. Based on 1999 marketing data about 10 out of 30 wineries are marketing less than 1000 gallons of wine per year and wine business is not their sole source of income. These producers with limited resources of time and capital are not likely to be interested in making value added products. The small size of operation and limitations mentioned above may explain the lack of interest shown by about half the responding winemakers.

The survey also revealed that about 36.8% (7 out of 19) winemakers would be definitely interested and another 15.8% (3 out of 19) would probably be interested in producing a value added product from surplus fruit. This group of winemakers, however, has no preference for processing either apples or peaches. They would be equally happy to process both. It is important to note that a majority (87.5%) of them would need technical help in setting up and running the operation of value added facility.

Another point indicated by the survey is that as a group majority of fruit producers are strongly interested in developing marketing arrangements to sell their crop to wineries but many winemakers are not as enthusiastic.

Although about 36.8% of the winemakers have expressed a definite interest in working with growers, as a group their efforts could be significant in providing relief to growers with surplus fruit crop.

Winemakers are already producing value added products from grapes. Their interest in making another value added product from apples and/or peaches could be greater (than found in the survey) if they could be convinced of its profitability, in spite of their lack of investment capital and technical competence. What remains to be done is to develop a working business model so the wineries can see the business opportunity of producing and marketing a value added product from surplus apples and peaches.

Report - Fruit Producers Survey
Patrick Byers
Fruit Grower Advisor
SMSU Department of Fruit Science

A survey of tree fruit producers was conducted in spring 2001 to investigate the feasibility of producing value added products from surplus apples and peaches produced in Missouri. Respondents to the survey numbered 29. Most of the respondents (27) produce apples, while 22 respondents produce peaches.

Comments

The survey revealed that 23 of 29 respondents had surplus apples that could be used to produce value added products, and the average quantity per orchard was 1588 bushels. Unlike apples, most respondents (18 of 29) indicated that they did not have surplus peaches available. Of the orchards that did have surplus peaches, the average quantity was 218 bushels.

A number of the apple growers who responded to the survey produce value added products from apples (17 of 29). These products include apple cider, apple butter, apple jam/jelly, and other items. None produced wine or brandy. Few respondents (6 of 29) produce value added products from peaches. These products include jam/jelly, peach butter, baked goods, and peach preserves. Again, no production of peach wine or brandy was reported on the survey.

Respondents were also asked if they needed help in developing marketing arrangements with a producer of value-added products. Statistical analysis of the responses indicated that fruit producers are interested in developing marketing arrangements with producers of value added products.

The survey response and analysis points out several interesting realities. Apple producers have a long history of producing value added products, particularly cider, and are interested in additional outlets for surplus fruit. At present the wholesale market prices for apples are relatively low, and growers are interested in additional outlets for relatively large quantities of fruit. Apples keep well in storage, and growers are used to dealing with the crop well after harvest. Peach growers, on the other hand, produce a crop that is much more perishable than apples. This, combined with the high value of the crop, ensures that much of the crop is sold quickly on the retail market following harvest. Little of the crop is available for value added processing. The price paid per bushel would have to be quite high to spawn much interest among peach producers in value added processing. At present there is not an extensive value added processing market for peaches. What potential that exists for value added products would possibly utilize the seconds or #2 fruit that may not find a ready market as fresh fruit. This fruit would have to be frozen and stored for most efficient use by a value added processor.

**INCREASE DIRECT MARKETING FOR FRUIT FARMERS
BY CONNECTING PRODUCER TO PRODUCER THROUGH RESEARCH
AND DEVELOPMENT OF A VALUE-ADDED PRODUCT
(STATISTICAL ANALYSIS)**

1. Univariate Analysis

1.1. Fruit Producers

Twenty-nine fruit producers participated in our survey. Majority of the respondents (based on the multiple responses) we surveyed produces apple and peach (see *Table 1*). In addition to apple and peach, some of them produce are pear, blackberry, blueberry, raspberry, grape, apricot, plum, nectarine, tomato, pumpkin.

Table 1. Distribution of Fruit Crops

Apple	Peach	Others
27/29	22/29	12/29
93.10%	75.86%	41.38%

About 79.31% of them say they have surplus apples that could be used to produce value-added products (VAP) while only 37.93% answer they have surplus peaches. On the average, there are 1588.545 bushels of apples and 218.125 bushels of peaches per orchards are available for this purpose. Comparing with apples, the availability of surplus peaches is very limited. Note that, however, the surplus amounts of apples and peaches between orchards vary quite big and also would vary from year to year.

About 58.62% answer they currently produce VAPs from apples while only 20.69% say they do from peaches. The popular types of VAPs from apples (based on multiple responses) are apple cider (44.83%), apple butter (20.69%), and apple jam and jelly (10.34%). From peaches, they mainly produce peach jam and jelly. Also, there seems to be some limitations of making various types VAPs from peaches.

The following *Table 2* shows whether they (out of 29 respondents) need any help in developing marketing arrangements with a producer of VAPs.

Table 2. Proportions of Responses (Fruit Producers)

Definitely would	Probably would	Might or might not	Probably would not	Definitely would not
12	8	4	4	1
41.38%	27.59%	13.79%	13.79%	3.45%

First, we need to determine whether the frequency counts in each category agree with a specified distribution. That is, are the categories chosen equally (each category has $1/5$ chance of being chosen) by the fruit producers? Thus, the null and alternative hypotheses of interest are

$$H_0 : p_1 = p_2 = p_3 = p_4 = p_5 = 1/5 \quad H_A : \text{At least one } p_i \neq 1/5 \quad (1)$$

By Pearson's chi-squared test for goodness-of-fit, we have $\chi^2 = 12.552$ (p-value = 0.0137). The p-value is very small and the null hypothesis H_0 is rejected. Based on these sample results, there is a highly significant evidence that the categories are not chosen equally by the respondents.

Secondly, more than $2/3$ (20 out of 29 responses) need help in developing marketing arrangements with a producer of VPAs. That is, larger portion of fruit producers wants to make surplus apples or peaches as VAPs. However, are their interests large enough to develop marketing arrangements with a producer of VAPs? To answer this, we summarize the responses using the scale of 1 to 5. Recall that scale 1 means "definitely would not" and 5 means "definitely would". Since the categories are ordinal, we are able to quantify the categories and make the arithmetic operations be meaningful. The null and alternative hypotheses of interest are

$$H_0 : \mu \leq 3 \quad H_A : \mu > 3 \quad (2)$$

That is, we want to check whether the category's scales are larger than 3. In other word, do they answer "Definitely would" and "Probably would" more often than the other categories? The value of test statistic is $t = 4.009$ (p-value = 0.0002). The p-value is small enough for the null hypothesis H_0 to be rejected. Thus, based on the results of 29 respondents, there is highly significant evidence to say that the fruit producers want to have marketing arrangements with a producer of VAPs.

1.2. Wine Makers

Nineteen wine makers participated in our survey. We asked them whether they are interested in producing and marketing VAPs from surplus apples or peaches. *Table 3* summarizes the results of their responses.

Table 3. Proportions of Responses (Wine Makers)

Definitely would	Probably would	Might or might not	Probably would not	Definitely would not
7	3	1	6	2
36.84%	15.79%	5.26%	31.58%	10.53%

First, we test whether each category is chosen equally or not like we did for the group of fruit producers. Under the same null and alternative hypotheses as in (1), the value of test statistic is $\chi^2 = 7.053$ (p-value = 0.133). The p-value is relatively large, so that the null hypothesis H_0 can not be rejected. Thus, there is insufficient evidence that the categories are not chosen equally by the respondents. Secondly, note that slightly larger than half (10 out of 19 responses) are interested in producing and marketing VAPs from surplus apples or peaches. However, are the wine makers really interested in? Under the same H_0 and H_A as in (2), the test statistic turns out to be $t = 1.045$ (p-value = 0.1549). The p-value is too large, so the null hypothesis H_0 can not be rejected. Thus, based on the results of 19 respondents, there is insufficient evidence to say that the wine makers are interested in producing and marketing VAPs from surplus apples or peaches.

As you can see in *Table 3* above, 8 out of 19 wine makers are not interested in marketing arrangement. Here are several reasons why they are not interested in: (1) they just start the wine business; (2) they want to produce grape production only; (3) they need capital investment for brandy production; (4) they wonder how it fits into their company; (5) they need additional equipment and knowledge; and (6) they have no license to make a brandy.

Note that the forthcoming analysis is only based on wine makers who are (and also might or might not) interested in marketing arrangement. They do not have any preference for processing apple or peaches. About 73% of them need some sort of technical assistance such as (1) equipment setup for distillation; (2) fruit process for fermentation; (3) methanol monitoring and procedures for keeping low; (4) advisement and financial assistance; and (5) production and marketing. Currently, 40% of them have a processing capability, and the others (who do not have) definitely want to build a new facility. Also, the majority (87.50%) needs help in setting up a distillation facility. Though

fruit is available, most of them (77.78%) want to start the processing after over a month. By looking at the returned survey forms carefully, we realized that the main reason is the new facility required for the processing.

2. Bivariate Analysis

2.1. Nonparametric Approach based on Ranking

Our main research question of interest is whether both of fruit producers and wine makers want to develop marketing arrangements between them. The analysis is only based on survey questionnaires 6 and 1 of fruit producers and wine makers, respectively. Recall that the questionnaires we wrote are

Q6 (Fruit Producers): Would you need help in developing marketing arrangements with a producer of value-added products? On a scale of 1 to 5, where 1 means “definitely would not” and 5 means “definitely would”, please circle one. (29 responses)

Def. would (5) / Prob. would (4) / Might or might not (3) / Prob. would not (2) / Def. would not (1)

Q1 (Wine Makers): Would you be interested in producing and marketing value-added products from surplus apples or peaches? On a scale of 1 to 5, where 1 means “definitely would not” and 5 means “definitely would”, please circle one. (19 responses)

Def. would (5) / Prob. would (4) / Might or might not (3) / Prob. would not (2) / Def. would not (1)

Table below shows the summary of their responses jointly. Category 5 is for “Definitely would”; category 4 is for “Probably would”; and so on.

Table 4. Joint Summary of Responses

Group \ Preference	category 5	category 4	category 3	category 2	category 1
Fruit Producers	12	8	4	4	1
Wine Makers	7	3	1	6	2

To check the relationship between the “preference” (five categories) in fruit producers and wine makers, we have used nonparametric approach based on rankings. First, we rank a set of categories according to their position on a scale such that the rank 1 stands for the most responses and 5 the least (see *Table 5*).

Table 5. Ranks of Five Categories based on Responses

Group \ Preference	category 5	category 4	category 3	category 2	category 1
Fruit Producers	1	2	3.5	3.5	5
Wine Makers	1	3	5	2	4

A glance at these rankings shows that there is far from being perfect agreement, but the populous choice made by two groups is “category 5 (Definitely would)”. To measure the degree of correspondence (rank correlation) between these two rankings, we have adopted two widely-used approaches when there exist some tied ranks. As a result, the conventional rank correlation coefficients $\tau = 0.527$ and the Spearman’s $\rho = 0.667$ show that there exists a certain degree of (positive) association or relationship between the “preference” (five categories) in fruit producers and wine makers.

To verify whether $\tau = 0.527$ and $\rho = 0.667$ are significantly different from zero (independence or no relationship between two groups), we conduct the testing of hypotheses. For τ and ρ , the null and alternative hypotheses of interest are

$$H_0 : \tau \text{ (or } \rho) = 0 \quad \text{vs.} \quad H_A : \tau \text{ (or } \rho) > 0$$

The relevant p-values are 0.180 for τ and 0.0795 for ρ . At the 5% significance level, it is insufficient to say that H_0 can be rejected for both cases. That is, the observed values are not statistically significant. As a result, “preference” of fruit producers and that of wine makers are not related.

A. PRELIMINARY ANALYSIS: Fruit Producers (29 Respondents)

Q1: What fruit crops do you produce? (29 responses)

Apple	Peach	Others
27/29	22/29	12/29
93.10%	75.86%	41.38%

Note that each Fruit Producer answers the multiple responses. Others are pear, blackberry, blueberry, raspberry, grape, apricot, plum, nectarine, tomato, pumpkin. Majority of the respondents we surveyed produces apple and peach.

Q2: Do you ever have surplus apples that could be used to produce value-added products? (29 responses)

Yes	No
23/29	6/29
79.31%	20.69%

Clearly, there are surplus apples.

Q2(a): If yes, could you estimate the quantity of apples that you would have available that could be used for this purpose? _____ (in bushel)? (22 responses, 1 non-response from the fruit producers who said "Yes" in Q2 above)

Mean	Standard Deviation	Minimum	1st Quartile	Median	3rd Quartile	Maximum
1588.545	2596.461	30	176.25	450	2250	10000

On the average, there are 1588.545 bushels per orchards. 15 (about 68.2%) out of 22 orchards have surplus apples less than or equal to 600 bushels. However, the surplus amounts between orchards vary quite big and also would vary from year to year.

Q3: Do you ever have surplus peaches that could be used to produce value-added products? (29 responses)

Yes	No
11/29	18/29
37.93%	62.07%

Unlike apples, the surplus peaches for VAP are limited.

Q3(a): If yes, could you estimate the quantity of peaches that you would have available that could be used for this purpose? _____ (in bushel)? (8 responses, 3 non-responses from the producers who said "Yes" in Q3 above)

Mean	Standard Deviation	Minimum	1st Quartile	Median	3rd Quartile	Maximum
218.125	242.221	10	38.75	175	312.5	750

Overall, there are not much surplus peaches that could be used to produce value-added products. On the average, there are 218.125 bushels per orchard. Also, these surplus amounts would vary from year to year. Comparing with apples, the average amount of surplus peaches is relatively small.

Q4: Do you currently produce value-added products from apples? (29 responses)

Yes	No
17/29	12/29
58.62%	41.38%

Q4(a): If yes, which products? (29 responses)

Apple Cider	Apple Butter	Apple Jam/Jelly	Others
13/29	6/29	3/29	6/29
44.83%	20.69%	10.34%	20.69%

Note that each Fruit Producer provides the multiple responses. Others are apple pie, apple wine, apple fruit roll, apple vinegar, diced apple, baked goods.

Overall, the more than half of Fruit Producers make several types of value-added products such as apple cider, apple butter, apple jam/jelly, etc. But, not a brandy or wine.

Q5: Do you currently produce value-added products from peaches? (29 responses)

Yes	No
6/29	23/29
20.69%	79.31%

Q5(a): If yes, which products? (29 responses)

Peach Jam/Jelly	Others
3/29	3/29
10.34%	10.34%

Note that each Fruit Producer provides the multiple responses. Others are peach butter, preserves, baked goods.

Unlike apples, making value-added products from surplus peaches is very limited.

Q6: Would you need help in developing marketing arrangements with a producer of value-added products? On a scale of 1 to 5, where 1 means “definitely would not” and 5 means “definitely would”, please circle one. (29 responses)

Def. would (5) / Prob. would (4) / Might or might not (3) / Prob. would not (2) / Def. would not (1)

Definitely would	Probably would	Might or might not	Probably would not	Definitely would not
12/29	8/29	4/29	4/29	1/29
41.38%	27.59%	13.79%	13.79%	3.45%

<<Step 1>> First, we need to determine whether the frequency counts in each category agree with a specified distribution. That is, are the categories chosen equally by the Fruit Producers? To answer this question, we need to conduct the hypothesis testing using the Pearson’s chi-squared test for goodness-of-fit. Since there are five categories, each has 1/5 chance (equally likely) of being chosen by the respondents. Thus, the null and alternative hypotheses of interest are

$$H_0 : p_1 = p_2 = p_3 = p_4 = p_5 = 1/5 \quad \text{vs.} \quad H_A : \text{At least one } p_i \neq 1/5$$

and reconstruct the table as

Preference <Fruit Producer>	Definitely would	Probably would	Might or might not	Probably would not	Definitely would not	Total
No. of Responses	12	8	4	4	1	29

Here the expected counts can be computed as $np_j = 29(1/5) = 5.8$ for category j . The chi-squared test statistic is

$$\chi^2 = \frac{(12 - 5.8)^2}{5.8} + \frac{(8 - 5.8)^2}{5.8} + \frac{(4 - 5.8)^2}{5.8} + \frac{(4 - 5.8)^2}{5.8} + \frac{(1 - 5.8)^2}{5.8} = 12.552$$

and the relevant p-value (degree of freedom = 4) is 0.0136855 from Splus statistical software. The p-value is very small and the null hypothesis H_0 is rejected. Based on these sample results, there is a highly significant evidence that the categories are not chosen equally by the respondents.

<<Step 2>> More than 2/3 (20 out of 29 responses) need help in developing marketing arrangements with a producer of value-added products. That is, large portion of the Fruit Producers wants to make surplus apples or peaches as value-added products. **But, are their interests large enough to develop marketing arrangements with a producer of value-added products?** To answer this, we summarize the responses using the scale of 1 to 5 as follows. Since the categories are ordinal, we are able to quantify the categories and make the arithmetic operations be meaningful.

Mean	Standard Deviation	Minimum	1st Quartile	Median	3rd Quartile	Maximum
3.897	1.205	1	3	4	5	5

The null and alternative hypotheses of interest are

$$H_0 : \mu \leq 3 \quad \text{vs.} \quad H_A : \mu > 3$$

That is, we want to check whether the category's scales are larger than 3. In other word, do they answer "Definitely would" and "Probably would" more often than the other categories? The test statistic for such hypotheses can be computed as

$$t = \frac{\bar{X} - \mu}{S/\sqrt{n}} = \frac{3.897 - 3}{1.205/\sqrt{29}} = 4.009$$

and the relevant p-value (degree of freedom = 28) is 0.0002053 from Splus statistical software. The p-value is small enough for the null hypothesis H_0 to be rejected. Thus, based on the results of 29 respondents, there is highly significant evidence to say that the Fruit Producers want to have marketing arrangements with a producer of value-added products

B. PRELIMINARY ANALYSIS: Wine Makers (19 Respondents)

Q1: Would you be interested in producing and marketing value-added products from surplus apples or peaches? On a scale of 1 to 5, where 1 means "definitely would not" and 5 means "definitely would", please circle one. (19 responses)

Def. would (5) / Prob. would (4) / Might or might not (3) / Prob. would not (2) / Def. would not (1)

Definitely would	Probably would	Might or might not	Probably would not	Definitely would not	Non-response
7/19	3/19	1/19	6/19	2/19	0
36.84%	15.79%	5.26%	31.58%	10.53%	–

<<Step 1>> We do the same method as Step 1 in Q6 of Fruit Producers. Assuming that each category has the equal chance of being chosen by the respondents, the null and alternative hypotheses of interest are

$$H_0 : p_1 = p_2 = p_3 = p_4 = p_5 = 1/5 \quad \text{vs.} \quad H_A : \text{At least one } p_i \neq 1/5$$

and the reconstructed table is

Preference <Wine Makers>	Definitely would	Probably would	Might or might not	Probably would not	Definitely would not	Total
No. of Responses	7	3	1	6	2	19

Here the expected counts can be computed as $np_j = 19(1/5) = 3.8$ for category j . The chi-squared test statistic is

$$\chi^2 = \frac{(12 - 3.8)^2}{3.8} + \frac{(8 - 3.8)^2}{3.8} + \frac{(4 - 3.8)^2}{3.8} + \frac{(4 - 3.8)^2}{3.8} + \frac{(1 - 3.8)^2}{3.8} = 7.053$$

and the relevant p-value (degree of freedom = 4) is 0.1331138 from Splus statistical software. The p-value is relatively large, so that the null hypothesis H_0 can not be rejected. Thus, there is insufficient evidence that the categories are not chosen equally by the respondents.

<<Step 2>> Slightly larger than half (10 out of 19 responses) are interested in producing and marketing value-added products from surplus apples or peaches. **However, are the wine makers really interested in?** To answer this, we summarize the responses using the scale of 1 to 5 as follows. We will use the same technique we had in the Step 2 of Q6 of Fruit Producers.

Mean	Standard Deviation	Minimum	1st Quartile	Median	3rd Quartile	Maximum
3.368	1.535	1	2	4	5	5

The null and alternative hypotheses of interest are

$$H_0 : \mu \leq 3 \quad \text{vs.} \quad H_A : \mu > 3$$

The test statistic for such hypotheses can be computed as

$$t = \frac{\bar{X} - \mu}{S/\sqrt{n}} = \frac{3.368 - 3}{1.535/\sqrt{19}} = 1.045$$

and the relevant p-value (degree of freedom = 18) is 0.15493 from Splus statistical software. The p-value is too large, so the null hypothesis H_0 can not be rejected. Thus, based on the results of 19 respondents, there is insufficient evidence to say that the Wine Makers are interested in producing and marketing value-added products from surplus apples or peaches.

If your choice is on a scale of either 1 or 2, please skip all the following questionnaire and tell us your reason. (7 responses, 1 non-response)

- Just getting started with wine.
 - Be focused on and dedicated to grape production.
 - Want to concentrate on producing the very best grapes we can, in order to produce great wine.
 - Capital investment for brandy production.
 - Can not see how it fits into our company.
 - Need additional equipment, knowledge. Need to improve on winemaking before changes, next might be champagne.
 - No license to make a brandy.
-

Q1(a): Do you have any preference for processing apples or peaches? (10 responses, 1 non-response from the Wine Makers who circled 5, 4, or 3 in the Q1 above)

No Preference	Apple	Peach	Non-response
8/10	0/29	2/10	1
80.00%	0.00%	20.00%	–

Obviously, there is no preference over apple and peach for processing among the Wine Makers who are interested in producing and making value-added products.

Please estimate the amount of fruit you would purchase: _____ (in bushel). (*The result of this questionnaire is not useful since there are only 4 responses. But, just check them for your reference.*)

Mean	Standard Deviation	Minimum	Maximum
1109.75	1349.341	10	3000

Q2: Would you need technical assistance in developing a value-added products? (11 responses)

Yes	No	Non-response
8/11	3/11	0
72.73%	27.27%	–

About 73% of the Wine Makers need some sort of technical assistance. See below for their specific needs.

Q2(a): If yes, what types? Please specify. (5 responses, 3 non-responses from the Wine Makers said “Yes” in the Q2 above)

- Distillation.
- Equipment setup for distillation. Fruit process for fermentation.
- Methanol monitoring and procedures for keeping low.
- Advisement and financial assistance.
- Production and marketing.

Q3: Do you have a processing capability? (10 responses, 1 non-response from the Wine Makers who circled 5, 4, or 3 in Q1 above)

Yes	No	Non-response
4/10	6/10	1
40.00%	60.00%	–

Q3(a): If yes, please estimate the size of capacity (i.e., volume or amount of production per day).
(This particular questionnaire is deleted due to the complete non-response.)

Q3(b): If no, would you be interested in building a new facility? (5 responses, 1 non-response from the Wine Makers who said “No” in Q3 above)

Yes	No	Non-response
5/5	0/5	1
100.00%	0.00%	–

As a whole (Q3 to Q3 (b)), the Wine Makers who do not have a processing capability are interested in building a new facility.

Q4: Would you need help in setting up a distillation facility? (8 responses, 3 non-responses from the Wine Makers who circled 5, 4, or 3 in Q1)

Yes	No	Non-response
7/8	1/8	3
87.50%	12.50%	–

Clearly, the majority needs help.

Q5: If fruit is available, how soon can you start the processing for value-added product? Please circle one. (9 responses, 2 non-responses from the Wine Makers who circled 5, 4, or 3 in Q1)

Immediately (4) / Within a week (3) / Within a month (2) / More than a month (1)

Immediately	Within a week	Within a month	More than a month	Non-response
2/9	0/9	0/9	7/9	2
22.22%	0.00%	0.00%	77.78%	–

Most of them have answered that it would take more than a month to start the processing. By looking at the returned survey forms carefully, we realized that the main reason was the new facility required for the processing.

C. RELATIONSHIP Between Fruit Producers & Wine Makers

Do both of Fruit Producers and Wine Makers want to develop marketing arrangements between them? The following analysis is based on Q6 of Fruit Producers and Q1 of Wine Makers

Recall that

Q6 (Fruit Producers): Would you need help in developing marketing arrangements with a producer of value-added products? On a scale of 1 to 5, where 1 means “definitely would not” and 5 means “definitely would”, please circle one. (29 responses)

Def. would (5) / Prob. would (4) / Might or might not (3) / Prob. would not (2) / Def. would not (1)

Q1 (Wine Makers): Would you be interested in producing and marketing value-added products from surplus apples or peaches? On a scale of 1 to 5, where 1 means “definitely would not” and 5 means “definitely would”, please circle one. (19 responses)

Def. would (5) / Prob. would (4) / Might or might not (3) / Prob. would not (2) / Def. would not (1)

Table below shows the summary of their responses jointly. Category 5 is for “Definitely would”; category 4 is for “Probably would”; and so on.

Group \ Preference	category 5	category 4	category 3	category 2	category 1
Fruit Producers	12	8	4	4	1
Wine Makers	7	3	1	6	2

Here we are interested in whether there is any relationship between the “preference” (five categories) in Fruit Producers and Wine Makers. Unfortunately, there is no direct parametric approach available for this particular situation. Instead, we could think of nonparametric approach based on ranking. Let’s rank a set of categories according to their position on a scale. Note that the rank 1 stands for the most responses and 5 the least.

Group \ Preference	category 5	category 4	category 3	category 2	category 1
Fruit Producers	1	2	3.5	3.5	5
Wine Makers	1	3	5	2	4

A glance at these rankings shows that there is far from being perfect agreement, but the populous choice made by two groups is “category 5 (Definitely would)”. Now what we wish to do is to measure the degree of correspondence between these two rankings, or to measure the intensity of rank correlation. There are several methods available, but I have adopted two widely-used approaches when there exist some tied ranks.

First method for the coefficient of rank correlation is called the τ (tau) which is defined by

$$\tau = \frac{P - Q}{\sqrt{\frac{1}{2}n(n-1) - T} \sqrt{\frac{1}{2}n(n-1) - U}} \quad -1 \leq \tau \leq 1$$

where

$$T = \frac{1}{2} \sum_t t(t-1) \quad U = \frac{1}{2} \sum_u u(u-1)$$

t (and u) is the number of consecutive members tied. P is the total of positive scores and Q is the total of negative scores. Based on our data set, the scores are

Group \ Preference	category 5	category 4	category 3	category 2
Fruit Producers	+1 +1 +1 +1	+1 +1 +1	0 +1	+1
Wine Makers	+1 +1 +1 +1	+1 -1 +1	-1 -1	+1
SCORES	+1 +1 +1 +1	+1 -1 +1	0 -1	+1

Thus, from the row “SCORES”, $P = 7$ and $Q = 2$. There is one tie ($t=2$) in the Fruit Producers and no tie ($u=1$) in the Wine Makers. So, $T = \frac{1}{2} \cdot 2(2-1) = 1$ and $U = 0$. Therefore,

$$\tau = \frac{7-2}{\sqrt{9}\sqrt{10}} = 0.527$$

Second method for the rank correlation is called the Spearman's ρ (rho) and computed by

$$\rho = \frac{\frac{1}{6}(n^3 - n) - S(d^2) - T' - U'}{\sqrt{\frac{1}{6}(n^3 - n) - 2T'} \sqrt{\frac{1}{6}(n^3 - n) - 2U'}} \quad -1 \leq \rho \leq 1$$

where

$$T' = \frac{1}{12} \sum_t (t^3 - t) \quad U' = \frac{1}{12} \sum_u (u^3 - u)$$

with $S(d^2)$ is the sum of the squared difference. This method is based on the difference between the ranks of the Fruit Producers and Wine Makers.

Group \ Preference	category 5	category 4	category 3	category 2	category 1
Fruit Producers	1	2	3.5	3.5	5
Wine Makers	1	3	5	2	4
Difference d	0	-1	-1.5	1.5	1
Difference d^2	0	1	2.25	2.25	1

$$T' = \frac{1}{12}(2^3 - 2) = \frac{1}{2}; \quad U' = \frac{1}{12}(1^3 - 1) = 0; \quad S(d^2) = 6.5$$

Therefore,

$$\rho = \frac{\frac{1}{6}(5^3 - 5) - 6.5 - \frac{1}{2} - 0}{\sqrt{\frac{1}{6}(5^3 - 5) - 2 \cdot \frac{1}{2}} \sqrt{\frac{1}{6}(5^3 - 5) - 2 \cdot 0}} = \frac{13}{\sqrt{19}\sqrt{20}} = 0.667$$

As a result, the rank correlation coefficients $\tau = 0.527$ and $\rho = 0.667$ show that there exists a certain degree of (positive) association or relationship between the “preference” (five categories) in Fruit Producers and Wine Makers.

However, given a value of a rank correlation in a sample, how far can we conclude that there exists correlation in the population from which the sample was chosen. That is, we should try to test the significance of observed rank correlations (τ , ρ) in the special sense of the statistical theory of sampling.

For τ and ρ , the null and alternative hypotheses of interest are

$$H_0 : \tau \text{ (or } \rho) = 0 \quad \text{vs.} \quad H_A : \tau \text{ (or } \rho) > 0$$

Note that τ or ρ being 0 means the independence (no relationship between two groups) while (> 0) implies the positive relationship. The relevant p-values are 0.180 for τ and 0.0795 for ρ . At the 5% significance level, it is insufficient to say that H_0 can be rejected for both cases. That is, the observed values are not statistically significant. As a result, “preference” of Fruit Producers and that of Wine Makers are not related.

Why this happens? As you can see in the table, Fruit Producers are very much interested in marketing arrangements while Fruit Producers are relatively not. 10 out of 19 Fruit Producers are positive about developing marketing arrangements, but still 8 of 19 are negative. Based on their responses in other questionnaires (see PRELIMINARY ANALYSIS A & B), Fruit Producers are having hard time to generate value-added products from their surpluses while Wine Makers seem to be interested in producing wine from grapes. In order to make Wine Makers have more interests on these marketing arrangements, they should be told the result of market analysis, such as value-added products from apples or peaches are also profitable (or even more profitable than grapes). I have no idea about how many Wine Makers are in the state of Missouri, but we may have the better outcomes if we could obtain a bit more responses from the Wine Makers (19 responses are relatively small).

Dear Fruit Producer:

We are investigating the feasibility of producing value-added products from surplus apples and peaches grown in Missouri. These products include brandies and other products containing fruit brandies. In order to assess the potential for producing these value-added products, we are surveying the Missouri apple and peach industries and would like to ask for your assistance.

Please fill out the requested information in the following questionnaire and return in the stamped and addressed envelope. Your cooperation is appreciated!

1. What fruit crops do you produce? _____

2. Do you ever have surplus apples that could be used to produce value-added products?

Yes

No

2 (a). If yes, could you estimate the quantity of apples that you would have available that could be used for this purpose? _____ (in bushel)

3. Do you ever have surplus peaches that could be used to produce value-added products?

Yes

No

3 (a). If yes, could you estimate the quantity of peaches that you would have available that could be used for this purpose? _____ (in bushel)

4. Do you currently produce value-added products from apples?

Yes

No

4 (a). If yes, which products? _____

5. Do you currently produce value-added products from peaches?

Yes

No

5 (a). If yes, which products? _____

6. Would you need help in developing marketing arrangements with a producer of value-added products? ? On a scale of 1 to 5, where 1 means "definitely would not" and 5 means "definitely would", please circle one.

Definitely would / Probably would / Might or might not / Probably would not / Definitely would not
5 4 3 2 1

Thanks for your cooperation! Please return the completed survey in the enclosed stamped envelope.

Legends for "Fruit Producers"

[illegible]

[illegible]

1. Would you be interested in producing and marketing value-added products from surplus apples or peaches? On a scale of 1 to 5, where 1 means "definitely would not" and 5 means "definitely would", please circle one.

Definitely would / Probably would / Might or might not / Probably would not / Definitely would not
5 4 3 2 1

If your choice is on a scale of either 1 or 2, please skip all the following questionnaire and tell us your reason:

Otherwise, please continue to answer.

1 (a). Do you have any preference for processing apples or peaches? _____

Please estimate the amount of fruit you would purchase: _____ (in bushel)

2. Would you need technical assistance in developing a value-added product?

Yes

No

2 (a). If yes, what types? Please specify _____

3. Do you have a processing capability?

Yes

No

3 (a). If yes, please estimate the size of capacity (i.e., volume or amount of production per day): _____

3 (b). If no, would you be interested in building a new facility?

Yes

No

4. Would you need help in setting up a distillation facility?

Yes

No

5. If fruit is available, how soon can you start the processing for value-added product? Please circle one.

Immediately / Within a week / Within a month / More than a month
4 3 2 1

Thanks for your cooperation! Please place the completed survey in the enclosed stamped envelope.

Legends for "Wine Makers"

[illegible]

[illegible]



Southwest Missouri State
U N I V E R S I T Y

March 15, 2001

Dear Fruit Producer/Vintner:

The fruit production and processing industries offer great opportunities for the development of value added products. As part of the ongoing research and advisory programs at the State Fruit Experiment Station of Southwest Missouri State University, we are investigating the feasibility of producing value-added products from surplus apples and peaches grown in Missouri. These products include brandies and other products containing fruit brandies.

In order to assess the potential for producing these value-added products, we are surveying Missouri apple and peach producers, as well as winemakers who may be interested in producing value-added products. Please take a few minutes to fill out the requested information in the following questionnaire and return in the stamped and addressed envelope. The survey is anonymous. Your cooperation is appreciated!

Sincerely,

Murli Dharmadhikari
Enology Advisor

Patrick Byers
Fruit Grower Advisor

We are investigating the feasibility of producing value-added products from surplus apples and peaches grown in Missouri. These products include brandies and other products containing fruit brandies. In order to assess the potential for producing these value-added products, we are surveying the Missouri apple and peach industries and would like to ask for your assistance.

1. What fruit crops do you produce? _____

Yes

No

3. Do you ever have surplus peaches that could be used to produce value-added products?

Yes

No

4. Do you currently produce value-added products from apples?

Yes

No

4 (a). If yes, which products? _____

5. Do you currently produce value-added products from peaches?

Yes

No

5 (a). If yes, which products? _____

Definitely would / Probably would / Might or might not / Probably would not / Definitely would not
5 4 3 2 1

Thanks for your cooperation! Please return the completed survey in the enclosed stamped envelope.

1. Would you be interested in producing and marketing value-added products from surplus apples or peaches? On a scale of 1 to 5, where 1 means "definitely would not" and 5 means "definitely would", please circle one.

Definitely would / Probably would / Might or might not / Probably would not / Definitely would not
5 4 3 2 1

If your choice is on a scale of either 1 or 2, please skip all the following questionnaire and tell us your reason:

Otherwise, please continue to answer.

1 (a). Do you have any preference for processing apples or peaches? _____

Please estimate the amount of fruit you would purchase: _____ (in bushel)

2. Would you need technical assistance in developing a value-added product?

Yes

No

2 (a). If yes, what types? Please specify _____

3. Do you have a processing capability?

Yes

No

3 (a). If yes, please estimate the size of capacity (i.e., volume or amount of production per day): _____

3 (b). If no, would you be interested in building a new facility?

Yes

No

4. Would you need help in setting up a distillation facility?

Yes

No

5. If fruit is available, how soon can you start the processing for value-added product? Please circle one.

Immediately / Within a week / Within a month / More than a month
4 3 2 1

Thanks for your cooperation! Please place the completed survey in the enclosed stamped envelope.

ATTACHMENT B

Goal 2 Report

Introduction

Many farmers in the State of Missouri produce apples and peaches. Most of their harvest is sold in the fresh produce market. A significant proportion of the harvest, however, is fed to cattle or discarded. This section of the study investigates whether a potential market exists for value-added products from surplus peaches grown in Missouri. These products include eau de vies (fruit brandies) and other value-added products containing fruit brandies. First, an overall trend in the United States (U.S.) market for alcoholic beverages is analyzed using the data from U.S. household expenditures survey. The value of current and projected U.S. and Missouri market is estimated. Second, the market potential of the proposed products is analyzed based on the survey among dealers of liquors in Missouri and interviews with few Springfield retailers. Finally, the highlights of the findings are listed in the summary and conclusion section of the report.

Objectives

1. Analyze a general trend in expenditures on alcoholic products in the US and particularly in Missouri
2. Evaluate the market for brandy and brandy products made out of Missouri peaches

Data and Limitations

Objective 1

Continuing Expenditures Survey (CES) conducted by Bureau of Labor Statistics (BLS), U.S. Department of Labor in 1997-98 is the primary source of analysis for evaluating trend and size of alcoholic beverage market in US including Missouri market.

The CES contains the most recent and comprehensive data available on food spending by American Households. The dairy survey obtains data on small, frequently purchased items that are normally difficult to recall, including food and beverages, tobacco, housekeeping supplies, non-prescription drugs, personal care products and services, fuels, and utilities. This diary survey excludes expenditures incurred while respondents are away from home overnight or longer. Therefore, market trend for alcoholic products determined in this section reflects only the household level market. It is, however, recognized that institutional market such as restaurants, hotel, airline services, etc constitutes a significant market for alcoholic beverages. A comprehensive survey is required to obtain the desired information on institutional market for alcoholic products.

Objective 2

Several dealers of alcoholic products excluding beer were mailed a brief survey instrument (Appendix 1) to obtain a general assessment of market for brandy and brandy products made out of Missouri peaches. Less than 50 percent of the 22 dealers responded either through completed questionnaire or through telephone interviews at the follow-up sessions. Most of the dealers did not provide the data regarding the volume of their operation, particularly sales of brandy products in dollar terms. Those who responded, however, reported a qualitative assessment of potential market of brandy and brandy products made out of Missouri peaches.

General Trend in the U.S. Market for Alcoholic Beverages

In the past decade, the alcoholic beverages market including wine, beer, and hard liquors had a sluggish growth and a continued pricing pressure, with deep pockets of robust expansion in such segments as imported beers, single-malt scotch and varietal wines (Khermouch, 1998). Using the per capita expenditures and the estimated population, the total dollar value of the alcoholic beverage market in the United States was estimated to be \$87 billion in 1999. Compared to 1989 there was a 23 percent growth in the dollar value of alcoholic beverage market. Although, the per capita expenditures on the alcoholic beverages increased to \$318 in 1999 from \$284 in 1989, the decade experienced a deep decline during 1993 to 1995 (Figure 1). The market varied among the income groups with the largest income group (more than \$70,000 per year) spending as much as \$696 per person in 1989. Among the income groups, however, only the lowest income group (less than \$30,000 per year) showed any significant growth in per capita expenditures on alcoholic expenditures (Figure 2). The disparity in expenditures was found in terms of age group with the consumers between 25-34 spending the most (Figure 3). Thus, the trend analysis suggests that young consumers with income level at the early stage of the working life represent the market segment with the highest potential for alcoholic beverages.

Beer market represents the largest segment in the alcoholic beverage. With a few large domestic producers such as Anheuser-Busch Inc. (47 percent market share), Miller Brewing Co. (41 percent market share), Coors Brewing Co. (10.5 percent market share) and imports, this segment is characterized by vicious price war.

The US spirits market in 1996 was estimated to be 135 million cases based on the total shipments of cases from liquor wholesale warehouses (Underwood, 1997). The spirits segment has been trying to attract younger consumers by capitalizing their interest in cocktail culture. To make liquors more palatable to youthful tastes products were introduced with new flavor and consumption ways for example flavored vodkas and new ways of consuming aperitifs such as Campari (with orange juice) in keeping with contemporary consumers' interest in lighter, sweeter offerings. Flavors are providing many players in the spirits industry with an entree to new markets (Underwood, 1997). While rum distillers are vying for gin drinkers and gin makers are trespassing on vodka's turf, such flavor experimentation is giving the entire spirits industry something to innovate with and its first real push in years. Marketers throughout the spirits industry are wrestling with whether to introduce new flavors or pour more marketing money behind existing products.

Flavored spirits seem natural in a marketplace where craft beers, varietal wines, low-alcohol refreshers, ice teas with juice, and rich, gourmet coffees are attracting young adults and driving sales in their respective categories. Familiar flavors like berry, lemon and vanilla give unseasoned drinkers a place to start. Missouri peach growers may be able to tap this market by introducing peach brandy as a flavor to be mixed with other alcoholic beverages.

Size of Missouri Market for all types of Alcoholic Beverage

The per capita expenditures on alcoholic beverages varied among four geographical regions in the United States. In 1999, Midwest was the third in the ranking

in terms of the per capita expenditures on alcoholic beverages with \$324 per person per year. However, in terms of the growth in per capita expenditures since 1989 Midwest was second with 17.82 percent. The first region in this category was northeast with 20.72 percent growth rate. Using the regional per capita expenditures figure and the projected population growth, Figure 4 shows the growth of the estimated size of alcoholic beverage market for Missouri. According to the estimate, the dollar value of alcoholic beverage market including all types of alcoholic beverages in 2000 was \$1.8 billion, which is projected to be slightly more than \$2 billion in 2005.

Market Potential for Brandy and Brandy Products Made out of Missouri Peaches

This section of the report is based on the information collected through a survey of Missouri hard liquor dealers. The addresses and phone numbers of alcoholic beverage dealers were received for the Missouri License Department. The list is attached in Appendix 2. Of the 116 dealers, a majority were dealers of beer only. After an initial screening through telephone, 22 hard liquor dealers were identified. A short questionnaire was sent to each of the short-screened dealers. The questionnaire intended to obtain information regarding volume of operation, product range including brandy or brandy products, fruit brandy products and their flavor, sources of merchandise (imported or locally produced), market potential for brandy products made out of Missouri peaches, and market segmentation in terms of household vs. institutional market including restaurants and other food service sectors.

Only 10 out of 22 dealers responded (a response rate of 45 percent). In general, this is a very good response rate. However, due to small population size the actual

number of response is not sufficient to carry out any statistical analysis. In addition to that a few retailers such as Albertsons and Dillons were also interviewed. A descriptive analysis based on the information from individual response is carried out.

A majority of the dealers who responded were primarily wine dealers with 15% or less of their total sales volume contributed by the hard liquor. Hard liquor sales among the dealers in this category ranged from \$2,000 to \$15,000 a month. Those who had large proportion of sales (more than 50 %) attributed to hard liquor sold as much as \$250,000 a month in terms of hard liquor. Many of the respondents did not want to provide operational information.

Vintage port, domestic fortified, infused shakes are some of the brandy products sold by the dealers. It is concluded from the interview with the retailers that most consumers prefer brandy products made out of grapes. Brandy made out of the other fruits are extremely small segment of the market. These brandy products are used for cooking purposes instead of drinking. Peach, apricot, and blackberry are among the other fruit flavors used. A majority of the brandy products sold by the dealers are imported brands made in France, Germany, Italy, etc. However, more than 50% of the brandy products sold by few dealers are domestically produced. These are produced mostly in California.

Dealers were asked to assess the market potential for the brandy products made out of Missouri peach. A majority of the respondents reported that brandy products made out Missouri peaches may be sold as a low valued products for cooking purposes to the institutional buyers such as restaurants and other food service sectors. The highlights from the conversation with the dealers are as follows:

1. The volume of the market for brandy made out of Missouri peach is too small to achieve cost efficiency. There are other sources for alcohol that are more economical.
2. Fruit based brandies and portals are a very small category that have several producers in France, Germany, Italy, and Spain. Due to the small volume of market even these producers find it difficult to sale their products in Missouri. A Missouri product might have a chance because of the local demand and if market is developed through an effective state-wise promotion. However, initially the volume of the potential market will be very small.
3. Missouri peach brandy producers could take a lesson from Missouri wine. Producers involved must not be discouraged by slow growth. The Missouri wine makers will have to be of great assistance to make this work.

Summary and Conclusion

The U.S. alcoholic beverages market including wine, beer, and hard liquors has been going through a sluggish growth and a continued pricing pressure, with deep pockets of robust expansion in such segments as imported beers, single-malt scotch and varietal wines. The total dollar value of the alcoholic beverage market in the United States was estimated to be \$87 billion in 1999. The market varied among the income groups and age groups. Consumers between 25-34 and with income level at the early stage of the working life represent the market segment with the highest growth potential for alcoholic beverages.

To make liquors more palatable to youthful tastes products are being introduced with new flavor and consumption ways. This particular trend provides the most important reason for the potential success of the brandy and brandy products based on Missouri peaches. Successful niche marketing among the young adults may provide a viable marketing alternative for the proposed products.

Existing dealers and retailers sold small volume of flavored brandy products with peach being one of the least preferred categories. Most brandy products are imported and are made out of grapes. The dealers cite the small volume of market with already existing competitors as the main reason for potential failure. However, many dealers are optimistic that a well-developed market is possible for brandy products made out of Missouri peaches.

Table 1: Per capita expenditures on alcoholic expenditures among four U.S. regions

Year	NorthEast	Midwest	South	West
1989	304	275	232	360
1990	332	293	249	328
1991	335	261	250	358
1992	343	290	250	355
1993	314	250	215	334
1994	313	246	262	309
1995	327	261	242	307
1996	353	310	273	323
1997	379	306	229	377
1998	368	284	249	378
1999	367	324	256	356

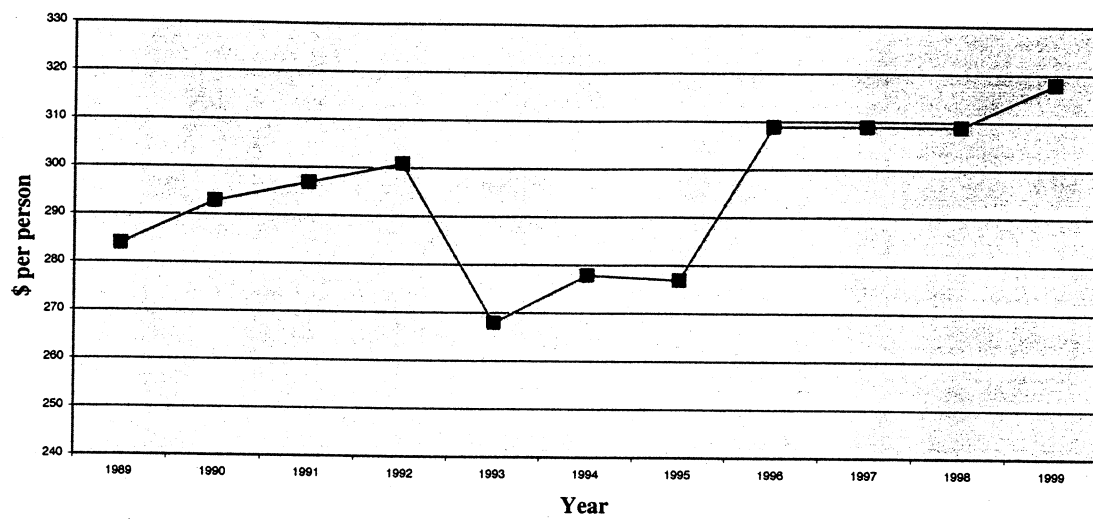


Figure 1: Annual Per Capita Expenditures on Alcoholic Beverages in the U.S.

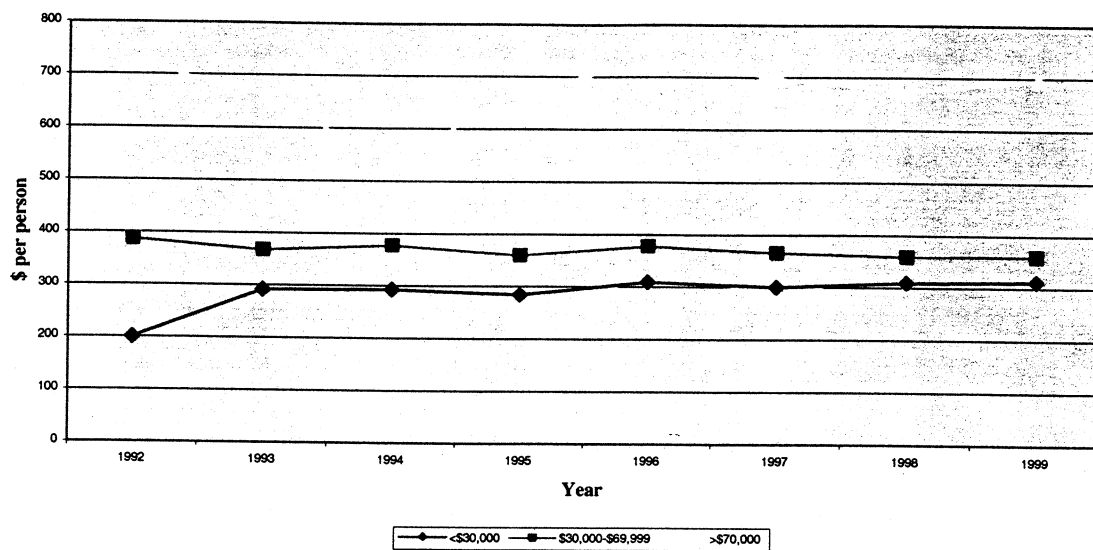


Figure 2: Distribution of Annual Household Expenditures on Alcoholic Beverages by Income Group

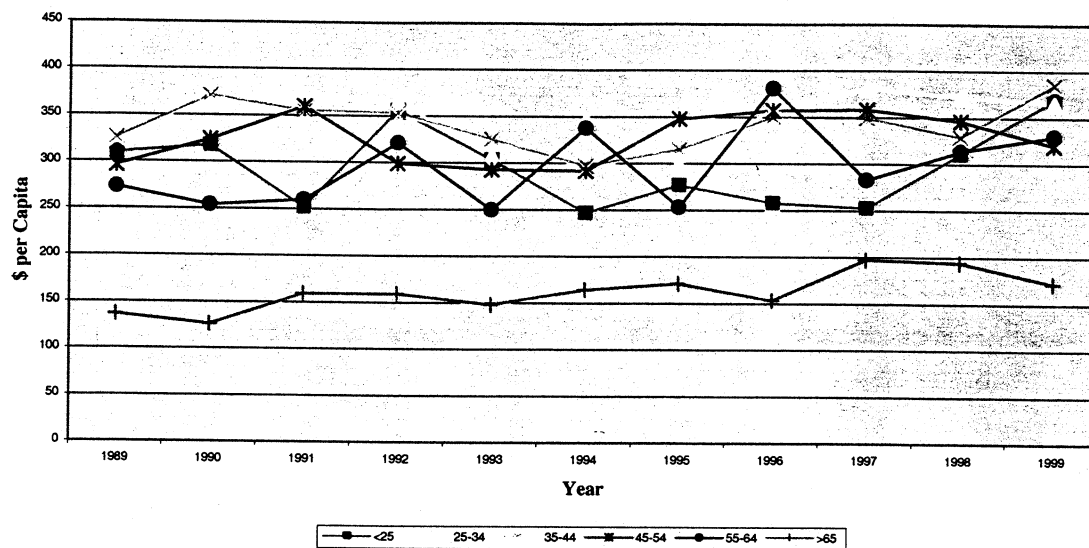


Figure 3: Age-wise Distribution of Annual Household Expenditures on Alcoholic Beverages

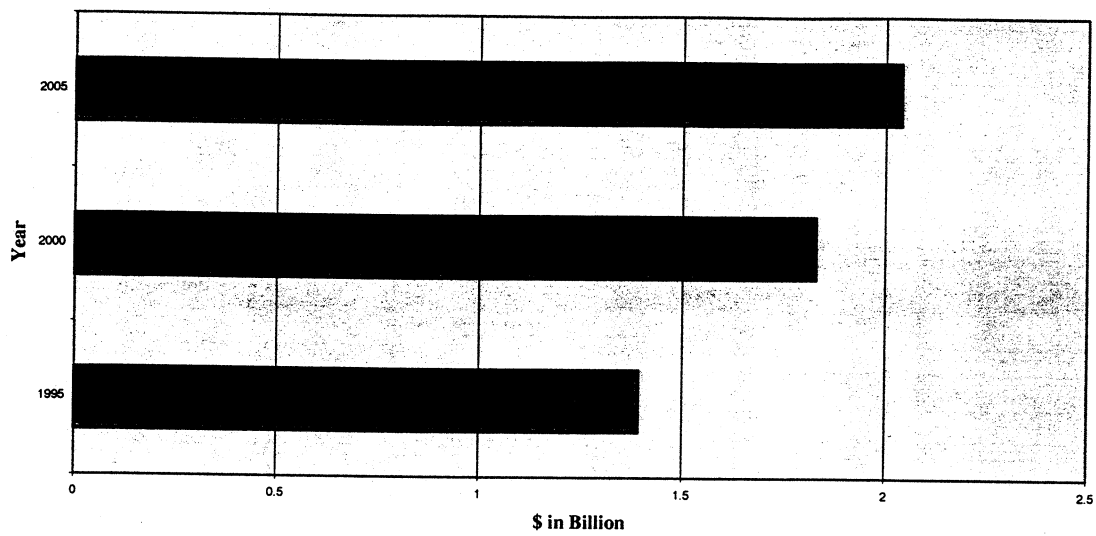


Figure 4: Estimated Market Size of Alcoholic Beverages in Missouri

Appendix 1: List of Alcoholic Beverage Dealers in Missouri

- 1 A. BOMMARITO WINES INC.,A. BOMMARITO WINES,2909,S
BRENTWOOD BLVD,BRENTWOOD,MO,63144,3149618996,LWS
- 2 ADAMS, RICHARD E.,CLASSIQUE WINES,1314,HANLEY INDUSTRIAL
COURT,BRENTWOOD,MO,63144,6365372907,LWS
- 3 ALL AMERICAN WINES INC.,ALL AMERICAN WINES,342,FEE FEE
ROAD,MARYLAND HEIGHTS,MO,63043,3142091738,LWS
- 4 ANHEUSER-BUSCH INC.,ANHEUSER BUSCH,,ONE BUSCH PLACE,ST
LOUIS,MO,63118,3145779998,5WS
- 5 ANHEUSER-BUSCH INC.,ANHEUSER-BUSCH,150A,TURNER BLVD,ST
PETERS,MO,63376,3143976100,32S
- 6 ANHEUSER-BUSCH INC.,ANHEUSER-BUSCH,1800,EAGLEVIEW
DRIVE,SEDALIA,MO,65301,3145779998,32S
- 7 BART RAMSOUR & SON INC.,,1720,W 7TH
STREET,JOPLIN,MO,64801,4176245419,5WS
- 8 BARTON BEERS LTD.,BARTON BEER,1701,ST LOUIS AVENUE,KANSAS
CITY,MO,64104,8162216131,32S
- 9 BBC MANAGEMENT COMPANY,BOULEVARD
BREWING,2501,SOUTHWEST BLVD,KANSAS
CITY,MO,64108,8164747095,32S
- 10 BBC MANAGEMENT COMPANY,BOULEVARD BREWING
COMPANY,2501,SOUTHWEST BLVD,KANSAS
CITY,MO,64108,8164747095,22WS
- 11 BIAS VINEYARDS & WINERY INC.,BIAS VINEYARDS &
WINERY,3166,HWY B,BERGER,MO,63014,5738345475,22WS
- 12 BIG SKY DISTRIBUTORS OF MO LLC,BIG SKY
DISTRIBUTORS,14220,WYANDOTTE,KANSAS
CITY,MO,64145,8169413300,22WS
- 13 BLUFF CITY BEER COMPANY INC.,BLUFF CITY BEER
COMPANY,521,HENDERSON AVE,POPLAR
BLUFF,MO,63901,5737859442,5WS

- 14 BLUFF CITY BEER COMPANY INC.,BLUFF CITY BEER COMPANY,450,SIEMERS DRIVE,CAPE GIRARDEAU,MO,63701,5736516228,5WS
- 15 BLUFF CITY BEER COMPANY INC.,BLUFF CITY BEER,1003,MCNUTT,HERCULANEUM,MO,63048,6369332408,5WS
- 16 BOB RALPH DISTRIBUTING COMPANY INC.,,115,LARCEL DRIVE,SIKESTON,MO,63801,5734715810,5WS
- 17 BOMMARITO WINES INC.,BOMMARITO WINES,2006,MAIN STREET,KANSAS CITY,MO,64108,8164711511,22WS
- 18 BRADLEY DISTRIBUTING COMPANY INC.,,HWY 25 NORTH,KENNETT,MO,63857,5738881173,22WS
- 19 C.G.S. DISTRIBUTING & ASSOCIATES INC.,CALVIN'S DISTRIBUTING COMPANY,177,HWY 100 WEST,HERMANN,MO,65041,5734863443,5WS
- 20 CHARLES E. BROWN BEVERAGE COMPANY,,,HWY MM,LEBANON,MO,65536,4175326157,5WS
- 21 CHARLES E. BROWN BEVERAGE COMPANY,CHARLES E. BROWN BEVERAGE,,HWY 71 & K,NEVADA,MO,64772,4176675530,5WS
- 22 CLASSIC CELLARS INC.,CLASSIC CELLARS,332,S FILLMORE AVE,KIRKWOOD,MO,63122,3149848988,LWS
- 23 COORS OF THE OZARKS INC.,CLEAR CREEK DISTRIBUTING COMPANY,2860,S AUSTIN,SPRINGFIELD,MO,65807,4178834333,5WS
- 24 CORKSCREW WINE COMPANY LLC,CORKSCREW WINE COMPANY,8500,NW RIVER PARK DRIVE PILLAR 239,PARKVILLE,MO,64152,8167469777,LWS
- 25 COUNTY BEVERAGE COMPANY INC.,,1290,SE HAMBLIN ROAD,LEE'S SUMMIT,MO,64081,8165254550,22WS
- 26 COUNTY DISTRIBUTING COMPANY INC.,,1800,EAGLEVIEW DRIVE,SEDALIA,MO,65301,6608265189,5WS
- 27 DENES, BELA S.,GREATLAND IMPORTING & DISTRIBUTING,9401,WATSON INDUSTRIAL PARK,CRESTWOOD,MO,63126,3143553733,LWS

- 28 DOMAINE IMPORTS LTD,DOMAINE IMPORTS,423,N
 CAMPBELL,SPRINGFIELD,MO,65806,4178662322,LWS
- 29 DOMAINE URSULA LLC,DOMAINE URSULA,11675,FAIRGROVE
 INDUSTRIAL BLVD,MARYLAND HEIGHTS,MO,63043,3149933719,LWS
- 30 DUFFY DISTRIBUTORS INC.,DUFFY DISTRIBUTORS,17,N FRANCIS
 STREET,CARTHAGE,MO,64836,4173587940,22WS
- 31 FECHTEL BEVERAGE & SALES INC.,,425,W ELM STREET,JEFFERSON
 CITY,MO,65101,5736365161,22WS
- 32 FRANK EVANS DISTRIBUTING COMPANY,FRANK EVANS
 DISTRIBUTING,501,OLIVER,JOPLIN,MO,64801,4176238585,22WS
- 33 FREERUN LLC,FREERUN,1933,E
 FLORIDA,SPRINGFIELD,MO,65802,4178694000,LWS
- 34 GARCO WINE COMPANY INC.,GARCO WINE COMPANY,4017,FOLSOM
 AVENUE,ST LOUIS,MO,63110,3146648300,LWS
- 35 GLOBAL GRAPE LLC,GLOBAL GRAPE,1285,DUNN ROAD,ST
 LOUIS,MO,63138,3148674440,22WS
- 36 GOLDEN BARREL INC.,GOLDEN BARREL,4401,I-70 DRIVE
 SE,COLUMBIA,MO,65201,5738868477,LWS
- 37 GOLDEN BEVERAGE LLC,GOLDEN BEVERAGE,20751,STATE ROUTE
 K,ST JOSEPH,MO,64505,8162322122,5WS
- 38 GOLDEN EAGLE DISTRIBUTING COMPANY,,,HWY
 168,HANNIBAL,MO,63401,5732210908,22WS
- 39 GOLDEN EAGLE DISTRIBUTING COMPANY,,1401,S OSTEOPATHY
 STREET,KIRKSVILLE,MO,63501,6606654461,22WS
- 40 GREAT RIVERS DISTRIBUTING COMPANY INC.,GREAT PLAINS
 DISTRIBUTING,407,THORNBURGH STREET,WEST
 PLAINS,MO,65775,4172562302,5WS
- 41 GRELLNER SALES & SERVICE INC.,,,HWY I-44 SOUTH OUTER
 RD,ROLLA,MO,65401,5732658829,22WS
- 42 GRELLNER SALES & SERVICE INC.,,RR 1,HWY
 5,CAMDENTON,MO,65020,5733467510,22WS

- 43 GRELLNER SALES & SERVICE INC.,GRELLNER SALES &
SERVICE,918,N MISSOURI AVE,WEST
PLAINS,MO,65775,4172564060,22WS
- 44 GREY EAGLE DISTRIBUTORS INC.,,2340,MILLPARK
DRIVE,MARYLAND HEIGHTS,MO,63043,3144299100,22WS
- 45 H. W. HERRELL DISTRIBUTING COMPANY,,1002,1ST
STREET,IMPERIAL,MO,63052,6364640100,5WS
- 46 H.L. PAUL DISTRIBUTING COMPANY INC.,,3475,E ROCK CREEK
ROAD,IMPERIAL,MO,63052,6362968850,5WS
- 47 HAMM SALES CO. OF SEDALIA MO.,D & D BEVERAGE,1218,W
MAIN,SEDALIA,MO,65301,6608270049,5WS
- 48 HEART OF AMERICA DISTRIBUTING INC.,HEART OF AMERICA
DISTRIBUTING,1510,W HENRY
STREET,SEDALIA,MO,65301,6608273581,22WS
- 49 HIGH LIFE SALES COMPANY,HIGH LIFE SALES COMPANY,1325,N
TOPPING AVE,KANSAS CITY,MO,64120,8164833700,LWS
- 50 HOFFMEISTER, LINUS C. JR. & MARY H.,SAINTE GENEVIEVE
WINERY,6231,HWY C,STE GENEVIEVE,MO,63670,5734832012,22WS
- 51 HOLSTEN IMPORT CORPORATION,B. UNITED
INTERNATIONAL,17,BARNES
LANE,CHAPPAQUA,NY,10514,9142387100,32S
- 53 JIM'S DISTRIBUTING COMPANY INC.,JIM'S DISTRIBUTING
CO.,201,FRANKLIN AVE,UNION,MO,63084,6365832002,22WS
- 54 K & M DISTRIBUTING COMPANY INC.,PREMIUM BEVERAGE
SALES,2855,S AUSTIN,SPRINGFIELD,MO,65807,4178870454,5WS
- 55 KENMARE DISTRIBUTORS INC.,KENMARE DISTRIBUTORS,1501,W
31ST STREET #516,KANSAS CITY,MO,64111,8165311111,LWS
- 56 KINKHORST BRUNSWICK DIST. COMPANY,BRUNSWICK
DISTRIBUTING CO.,RR 3,HWY 24
EAST,BRUNSWICK,MO,65236,6605483173,22WS
- 58 KOHLFELD DISTRIBUTING INC.,,4691,E JACKSON
BLVD,JACKSON,MO,63755,5732433931,22WS

- 59 KOHLFELD DISTRIBUTING INC.,,HWY EE &
I-55,MARSTON,MO,63866,5736432301,22WS
- 60 KOHLFELD DISTRIBUTING INC.,OZARK BEVERAGE,,HWY 67
SOUTH,POPLAR BLUFF,MO,63901,5737852724,5WS
- 61 KREY DISTRIBUTING COMPANY,KREY DISTRIBUTING,150,TURNER
BLVD,ST PETERS,MO,63376,6363976100,5WS
- 62 LANDRETH, RANDY D. & SMITH/WILLIAMS, B.,CIDER HAUS,515,E
MAIN STREET,RICHLAND,MO,65556,5737654073,22WS
- 63 LARRY HICKEY DISTRIBUTING COMPANY,LARRY HICKEY
DISTRIBUTING,3121,ENTERPRISE
AVE,JOPLIN,MO,64801,4176240550,22WS
- 64 LES BOURGEOIS VINEYARDS INC.,LES BOURGEOIS VINEYARDS,,HWY
BB,ROCHEPORT,MO,65279,5736982133,22WS
- 65 LIONSTONE INTERNATIONAL OF MISSOURI INC.,,314,FEE FEE
ROAD,MARYLAND HEIGHTS,MO,63043,3142987260,LWS
- 66 LLOYD DISTRIBUTING COMPANY INC.,,RR 1,HWY 11
WEST,KIRKSVILLE,MO,63501,6606651907,5WS
- 67 LOHR DISTRIBUTING COMPANY INC.,,1100,S 9TH STREET,ST
LOUIS,MO,63104,3142316400,LWS
- 68 LUECKE DISTRIBUTING COMPANY INC.,,HWY 67 S,POPLAR
BLUFF,MO,63901,5737851451,5WS
- 69 MAJOR BRANDS INC.,MAJOR BRANDS - COLUMBIA,1502,BUSINESS 70
WEST,COLUMBIA,MO,65202,5734433169,LWS
- 70 MAJOR BRANDS INC.,MAJOR BRANDS - ST. LOUIS,6701,SOUTHWEST
AVE,ST LOUIS,MO,63143,3146451843,LWS
- 71 MAJOR BRANDS INC.,MAJOR BRANDS - MOUND CITY LIQUOR
COMPANY,6701,SOUTHWEST AVE,ST LOUIS,MO,63143,3147710617,LWS
- 72 MAJOR BRANDS INC.,MAJOR BRANDS - CAPE GIRARDEAU,839,S
KINGSHIGHWAY,CAPE GIRARDEAU,MO,63701,5733358079,LWS

- 73 MAJOR BRANDS INC.,MAJOR BRANDS - SPRINGFIELD,455,N
BELCREST ROAD,SPRINGFIELD,MO,65801,4178692801,LWS
- 74 MAJOR BRANDS INC.,MAJOR BRANDS - ST. LOUIS,6701,SOUTHWEST
AVE,ST LOUIS,MO,63143,3146451843,32S
- 75 MAJOR BRANDS INC.,MAJOR BRANDS-KANSAS CITY,550,E 13TH
AVENUE,N KANSAS CITY,MO,64116,8162211070,LWS
- 76 MARK TWAIN DISTRIBUTING COMPANY INC.,MARK TWAIN
BEVERAGE,305,S 8TH STREET,HANNIBAL,MO,63401,5732214180,5WS
- 77 MARQUART BEVERAGE LLC,MARQUART BEVERAGE,423W,W
INDUSTRIAL DR,WASHINGTON,MO,63090,6362393115,5WS
- 78 MASSANDRA USA CORPORATION,MASSANDRA,1115,FOXWORTH
COURT,BALLWIN,MO,63011,3144398088,22WS
- 79 MCCORMICK WHOLESALE LIQUOR COMPANY,,HWY
JJ,WESTON,MO,64098,8166402276,LWS
- 80 MEADOR WINERY & VINEYARD INC.,MEADOR WINERY &
VINEYARD,5479,W MONTANA
LANE,JOPLIN,MO,64801,4176279463,22WS
- 81 MID-CONTINENT DISTRIBUTORS INC.,GLAZERS MIDWEST-ST
LOUIS,6501,HALL STREET,ST LOUIS,MO,63147,3143829990,LWS
- 82 MID-CONTINENT DISTRIBUTORS INC.,GLAZERS MIDWEST-KANSAS
CITY,5800,STILLWELL,KANSAS CITY,MO,64120,8162311188,LWS
- 83 MID-CONTINENT DISTRIBUTORS INC.,GLAZERS
MIDWEST-SPRINGFIELD,2810,N LECOMPTE
ROAD,SPRINGFIELD,MO,65802,4178695512,LWS
- 84 MID-CONTINENT DISTRIBUTORS INC.,GLAZERS
MIDWEST-COLUMBIA,4300,CHATEAU
ROAD,COLUMBIA,MO,65202,5734746153,LWS
- 85 MID-CONTINENT DISTRIBUTORS INC.,GLAZERS MIDWEST-CAPE
GIRARDEAU,3420,WILLOW DRIVE,SCOTT
CITY,MO,63780,5733358230,LWS

- 86 MISSOURI BEVERAGE COMPANY INC.,PIONEER WHOLESALE WINE &
LIQUOR COMPANY,401,WITHERS AVENUE,ST
LOUIS,MO,63147,3142315060,LWS
- 87 MORGAN, VERNON C. & JACOBS, CLIFFORD L.,JAMOR
DISTRIBUTING,1515,W DIVISION-SUITE
A,SPRINGFIELD,MO,65802,0,5WS
- 88 MPW INC.,MPW,5634,HIGH
STREET,AUGUSTA,MO,63332,6364824419,22WS
- 89 MULLALLY DISTRIBUTING COMPANY INC.,,,HWY I-44 & 19
SOUTH,CUBA,MO,65453,5738853371,5WS
- 90 N.H. SCHEPPERS DISTRIBUTING COMPANY,,1736,SOUTHRIDGE
DRIVE,JEFFERSON CITY,MO,65101,5736364831,22WS
- 91 N.H. SCHEPPERS DISTRIBUTING COMPANY,,1306,HATHMAN
PLACE,COLUMBIA,MO,65201,5734745666,22WS
- 92 NATIVE STONE VINEYARD INC.,NATIVE STONE & BULL ROCK
BREWERY,4317,NATIVE STONE ROAD,JEFFERSON
CITY,MO,65109,5735849749,22WS
- 93 NAUSER BEVERAGE COMPANY,NAUSER BEVERAGE
COMPANY,6000,PARIS ROAD,COLUMBIA,MO,65205,5734749848,22WS
- 94 NEMO BEER WHOLESALERS INC.,,,BREWINGTON
AVE,KIRKSVILLE,MO,63501,6606657659,22WS
- 95 NORTH KANSAS CITY BEVERAGE COMPANY INC.,,203,E 11TH AVE,N
KANSAS CITY,MO,64116,8164714895,22WS
- 96 O'MALLEY BEVERAGE INC.,,1601,N WOODBINE ROAD,ST
JOSEPH,MO,64506,8162790040,22WS
- 97 PARKER IMPORTS LLC,PARKER IMPORTS LLC,8201,E 23RD
STREET,KANSAS CITY,MO,64129,3148312403,22WS
- 98 PETER MICHAELS INC.,PETER MICHAELS,8500,NW RIVER PARK
DR-PILLAR 243,PARKVILLE,MO,64152,8165231977,LWS
- 99 PINNACLE IMPORTS LLC,PINNACLE IMPORTS,2391,GRISSOM
DRIVE,ST LOUIS,MO,63146,3149956822,22WS

- 100 PSCK INC.,ADAMS SALES COMPANY,,S MAIN STREET
ROAD,NEVADA,MO,64772,4176673774,5WS
- 101 ROBERT WILLIAMS & COMPANY INC.,ROBERT WILLIAMS &
COMPANY,10906,GALT INDUSTRIAL DRIVE,ST
LOUIS,MO,63132,3148321037,LWS
- 102 SCHNEIDER, JANINE K.,A TASTE OF WINE,19631,CANNONBALL
ROAD,WARRENTON,MO,63383,6364565107,22WS
- 103 SERRA MISSIONS CORPORATION,,852,HANLEY INDUSTRIAL
COURT,BRENTWOOD,MO,63144,3149624600,22WS
- 104 SLBS MANAGEMENT INC.,ST. LOUIS BEER SALES,4233,N UNION
BLVD,ST LOUIS,MO,63115,3143835574,LWS
- 105 SOARING EAGLE DISTRIBUTING INC.,SOARING EAGLE
DISTRIBUTING,319,N STATE
STREET,DESLOGE,MO,63601,5734312525,22WS
- 106 ST. JAMES WINERY INC.,ST. JAMES WINERY,540,SIDNEY STREET,ST
JAMES,MO,65559,5732657912,22WS
- 107 ST. JOSEPH BEVERAGE, LLC,ST. JOSEPH BEVERAGE,1422,S 6TH
STREET,ST JOSEPH,MO,64501,8166762337,5WS
- 108 STAFFORD, BRENT A.,PINNACLE BEERS,4,JENNIFERS
GLEN,O'FALLON,MO,63366,6362402106,22WS
- 109 SUPERIOR WINES & LIQUORS INC.,GLAZERS
MIDWEST-SUPERIOR,5800,STILLWELL,KANSAS
CITY,MO,64120,8162311188,LWS
- 110 T.L.C. INC.,O'FALLON BREWERY,26,W INDUSTRIAL
DRIVE,O'FALLON,MO,63366,6362812337,5WS
- 111 THILENIUS DISTRIBUTING COMPANY,RIVER EAGLE DISTRIBUTING
COMPANY,2346,RUST AVENUE,CAPE
GIRARDEAU,MO,63702,5733357717,5WS
- 112 TIGER COUNTRY BEVERAGE INC.,TIGER COUNTRY
BEVERAGE,6081,W VAN HORN TAVERN
ROAD,COLUMBIA,MO,65203,5738742337,22WS
- 113 UNITED BEVERAGE COMPANY LP,UNITED BEVERAGE
COMPANY,1903,WOODLAND,KANSAS CITY,MO,64108,8168424283,22WS

- 114 WEST PLAINS DISTRIBUTING COMPANY INC.,PREMIUM BEVERAGE
DISTRIBUTING COMPANY,134,N HOWELL AVE,WEST
PLAINS,MO,65775,4172564275,LWS
- 115 WIL FISCHER DISTRIBUTING COMPANY,WIL FISCHER
DISTRIBUTING,3539,W FARM ROAD
142,SPRINGFIELD,MO,65807,4178624341,22WS
- 116 7 SEAS BEVERAGE LLC,7 SEAS BEVERAGE,6008, N
INDBERGH,HAZELWOOD,MO,63042,3147312188,LWS

Appendix 2: Survey instrument used among 22 dealers dealing with hard liquors

XXX

Address

Dear XXX

Many farmers in the State of Missouri produce apples and peaches. However, only 15 percent of their harvest is sold in the fresh produce market. The rest is fed to cattle or discarded. We are investigating the feasibility of producing value-added products from surplus apples and peaches grown in Missouri. These product include eau de vies (fruit brandies) and other value-added products containing fruit brandies. In order to assess the potential for producing these value-added products, we are surveying the Missouri wine/liqueur dealers and would like to ask for your assistance. Your responses will remain confidential and will not be reported in any way to identify a participant.

Please fill out the requested information in the following questionnaire and return in the stamped and addressed envelope. Your cooperation is appreciated!

Sincerely,

Arbindra Rimal
Assistant Professor
Agriculture Department

1. What is the percentage distribution of your total dollar sales from the following products?

1.1	Wine	% _____
1.2	Beer	% _____
1.3	Hard Liquor	% _____

2. Could you provide a rough estimate of the average dollar value from your hard Liquor sale \$ _____ (Monthly or weekly)

3. How much of that would be brandy or brandy product sales \$ _____ (Monthly or weekly)

4. Do you sale fruit brandy or fruit brandy products such as ports and infusions?
Yes _____ No _____

5. If yes, what are the different flavors of fruit brandy and fruit brandy products do you sale?

5.1.

5.3.

5.5

5.2.

5.4.

5.6

6. What is the total dollar value of fruit brandy sold \$_____ (Monthly/Weekly)

7. Please provide the percentage of imported and locally produced fruit brandy and fruit brandy products sold? Imported_____ Locally produced_____

8. Do you think there is a market potential for fruit brandy and fruit brandy products made out of peaches and apples grown in Missouri to be marketed as

8.1 high valued drinking beverage

8.2 low valued for cooking purposes

8.3 No potential

9. If there is a market potential, who are the most likely target customers? (Please rank using a number. For example, if households are a number one potential customer then rank them as 1)

_____ 9.1 Households

_____ 9.2 Institutional customers such as restaurants, cafeteria, etc.

10. Please provide any additional remarks regarding the market potential of Missouri fruit brandy and fruit brandy products.

References:

Continuing Expenditures Survey (CES), Bureau of Labor Statistics (BLS), U.S.
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ATTACHMENT C

Goal 3 Report

INTRODUCTION

The purpose of this portion of the project was to establish a method to produce quality distillates of fruit brandy, and determine which varieties of fruit showed the most promise as a fruit brandy. Two types of distillates were studied, distillates that produce high quality sipping brandies and distillates that can be used to create other brandy products such as fruit ports and infusions. A pilot distillery was established at the Missouri State Fruit Experiment Station, which allowed researchers to distill various types of fruit and evaluate the fruit brandies before recommending them for commercial production.

METHODS AND MATERIALS

Fruits grown at the State Fruit Experiment station and fruits donated by the fruit industry of Missouri were used for this project. Each variety of fruit was mashed and fermented to dryness. No microbial antiseptics such as sulfur dioxide were added to the mash throughout or following fermentation. Yeast, yeast nutrients, and enzymes were added to aid fermentation. Analysis for percent titratable acidity, pH, and sugar content as °Brix was conducted pre-fermentation, and percent ethanol content was conducted post-fermentation. Three varieties of peaches, Red Haven, Crest Haven, and Encore were fermented as varietal batches, and one batch was a mix of these varieties. Four varieties of apples, Jonathon, Gayla, Red Delicious, and Ozark Gold were fermented as varietal batches. Since fruit quality has an effect on the fermentation, which in-turn affects the distillates produced, fruit quality was documented ¹. The fruit quality determination was based on the presence of bruises, molds, fungi, and the extent of insect damage in pits or cores.

A 3-plate 120 L column still was used for all distillations. A schematic diagram of a 120 L Christian-Carl still is shown in Figure 1. The operation of a steam jacket still is as follows. The still is operated by a steam jacket, which heats the mash to boiling under normal pressure conditions. Cooling water is passed through the total condenser and into the column-dephlegmator (partial condenser). The cooling water is kept at 23 °C at the top of the condenser and the flow of water into the column-dephlegmator is regulated. The purpose of the column-dephlegmator is to partially condense the distillate vapor, returning a portion of it as countercurrent distillate to be re-distilled. The three plates in the column are copper sieves, which the distillate vapors can pass through as they rise through the column. The countercurrent distillate drains back down and sits on the next lower plate to be re-distilled therefore increasing the efficiency of separation of different components. This process is called reflux and rectification ^{1,2,3}. The water in the column-dephlegmator will remain at 23 °C until the distillate vapor of the mash increases the temperature of the water. Alcohols with low boiling points vaporize at lower temperatures, and are referred to as the head cut of the distillate. As the temperature of the mash increases alcohols with higher boiling points begin to vaporize and are referred to as the heart cut of the distillate. Alcohols that boil at temperatures higher than approximately 88 °C are considered the tail cut of the distillate ². Table 1 shows the boiling points of the components commonly found in fruit distillate ^{3,4}. The increase in the temperature of the vapor raises the temperature of the dephlegmator as the vapors

come in contact with it. As the distillate vapors rise up through the column the vapors eventually move out of the top column and into the total condenser. The distillate vapor is then condensed and is collected as a liquid from the bottom of the total condenser ^{1,2}.

The distillation for this project involved 120 L of mash pumped into the pot of the still. Cooling water was circulated through the column-dephlegmator and the total condenser. The steam jacket was filled, and the pressure within the jacket was kept at 0.7 bar until reflux began on the third plate. Once reflux began on the third plate the pressure was reduced to between 0.3 and 0.4 bar for the remainder of product collection.

The product was collected in three stages, head, heart, and tail using sensory analysis to determine the cuts. The distillate was collected as cuts of 500-1000 ml (head) followed by several cuts of 1000 ml (heart) until a noticeable change in aroma from fruity to musty or rancid was detected. At the change in aroma 500 ml – 1500 ml (tail) cuts were collected as time permitted. The cuts were made based on sensory evaluation for the presence and then absence of acetaldehyde and ethyl acetate for the head cut, and the musty or rancid, off odors of higher alcohols for the tail cut.

The distillates were evaluated by sensory analysis. This involved reduction of the spirits to a drinkable grade of 40% using distilled water. Distilled water was used so that the water had no influence on the aroma and flavor of the distillate ¹. Sensory evaluation was then performed using aroma and flavor. This procedure was conducted at the time the distillates were collected and after a six-week aging period. The spirits were also evaluated by analytical separation of the components using a Hewlett Packard 6890 Gas Chromatography (GC) instrument with a flame ionization detector. This was done only to verify the cuts made by using sensory of head, heart, and tail cuts during the distillation process. One hundred and sixteen samples were collected from the distillation of seven varieties of fruit. Fifty-eight of the samples were run in duplicate as a representation of varieties distilled. The average value for each duplicate run was used to plot the trend of head, heart, and tail cut composition in relation to the sensory cut made at the time of distillation. A 30m Alltech EC-WAX (polyethylene glycol) capillary column with an inner diameter of 0.25 mm was used for all measurements. The initial conditions for the chromatographic analysis were: column temperature at 40 °C, injector port temperature of 240 °C, and the detector temperature at 255 °C. The temperature program used for the analysis was initially 40 °C and ramped at 25 °C/min until a temperature of 210 °C was reached. The temperature was held at 210 °C for 5 minutes. An injection of 0.5 µL was used with a split ratio on the column of 50:1. Each sample took 14.80 minutes to run. The samples were evaluated for their content of acetaldehyde, acetone, ethyl formate, ethyl acetate, methanol, ethanol, n-propanol, isopentyl alcohol (isoamyl alcohol), and benzaldehyde.

RESULTS

The separation of the head cut from the heart cut for all the varieties of peaches and apples was easily made by sensory as well as GC analysis. The disappearance of the aroma of acetaldehyde and ethyl acetate signified the cut at the time the distillates were

collected. This also proved to be true using GC analysis by the disappearance of these compounds from the GC chromatogram. Ethyl acetate was present on the GC chromatogram in early heart collections, but was undetectable by sensory analysis. Ethyl formate and acetone were also indicators for the head cut when present. Figure 2 shows two examples of the results from the GC analysis and where the cuts of head, heart, and tail were made using sensory at the time the product was collected. These charts were created from information in Table 2.1 and 2.2.

The total volume of alcohol collected and quantity of each cut varied with every variety of fruit. The starting sugar content and the fermentation process affected the total volume collected for each batch ^{1,2}. A higher total volume of alcohol was collected when the sugar content was greater and fruit quality was good to fair. Table 3 shows the variety, fruit quality, volume of cuts, and the pre and post-fermentation data. It was observed that the quality of fruit and conditions of fermentation appeared to have an affect on the percent volume of each cut. In fruit with poorer quality there was a higher volume of head cut and a reduced volume of heart. For example, Red Haven peaches of fair quality with an initial ethanol content of 5.8 % produced 500ml of head and 4000ml of heart. When a mix of Crest Haven and Red Haven peaches of poor quality fruit with an initial ethanol content of 5.2 % was distilled, it produced 1000mL of head and only 2000mL of heart. No pattern for the location of head, heart, and tail cuts was determined to exist between different varieties. For example, it could not be determined that all fruit required a 500ml cut for the head based on any one set of parameters.

It was found that all distillates collected carried the distinctive aroma of the fruit from which they were made. However, some varieties showed more characteristics of the fruit than others. Also the fruit aromas were found to be stronger by sensory analysis after a period of aging than they were at the time of collection. This is due to esterification that occurs during the aging process. Esters, fruity and aromatic aromas, are formed from a reaction of alcohol and acid producing water as a side product ^{1,2}.

DISCUSSION AND CONCLUSIONS

The purpose of this portion of the project was to establish a method to produce quality distillates of fruit brandy, and determine which varieties of fruit showed the most promise as a fruit distillate. Two types of distillates were studied, distillates that produce high quality sipping brandies and distillates that can be used to create other brandy products such as fruit ports and infusions. The highest quality portion of the distillate is found in the heart cut ². It possesses the most fruit character and the least amount of lower and higher alcohols that mask the fruit aromas of the fruit distilled.

No pattern for the location of cuts was determined to exist between different varieties. It could not be determined in this study that all fruit required a specific quantity, 500ml for example, for the head cut based on any one set of parameters. To make cuts of a specific volume would have sacrificed the quality of the heart in many of the trials by increasing the amount of acetaldehyde and ethyl acetate present in the heart. Also, setting specific quantities of heart to be collected after the head cut was made would have resulted in

either a decrease in quantity of good heart, or a decrease in quality of the heart due to higher alcohols of musty, rancid odors present in the heart cut. It was found that sensory was the best method for locating where to make the cuts. An in-depth study of a particular variety will need to be conducted to determine if a pattern for the location of head, heart, and tail cuts exists within a specific variety.

The results show that there is great opportunity with extended study to determine specific patterns necessary to create quality distillates from an individual variety of fruit. This preliminary study of many varieties of each, apple and peach, will lend itself to choosing a few specific varieties for further study. The Gayla apple and the Crest Haven peach showed the greatest promise to be a quality sipping fruit brandy. This determination was based on good varietal aroma and relatively larger quantity of distillate produced in a single batch. The other varieties show promise as good fortifying brandies for other products such as fruit ports and fruit infusions. This determination is based on the subtle aroma and limited volume output that would require the additional flavor and volume of a fruit wine or fresh fruit in the case of infusions.

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4. The Merck Index, 13th edition, Whitehouse Station, New Jersey, 2001

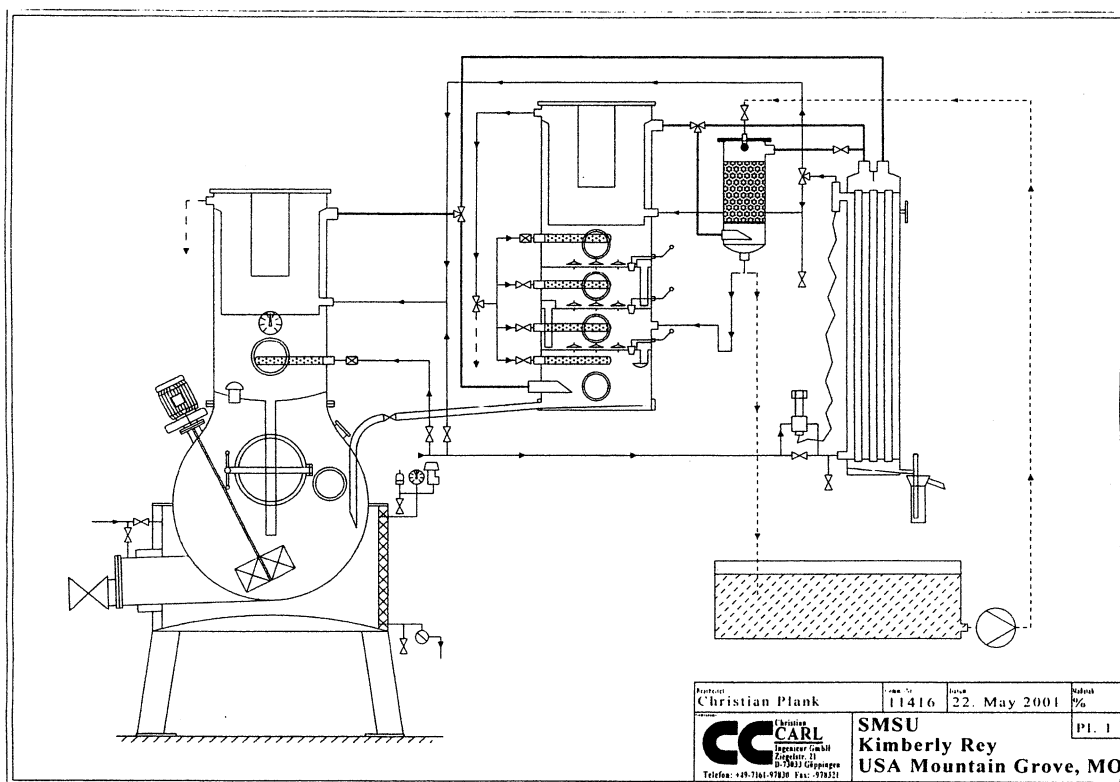
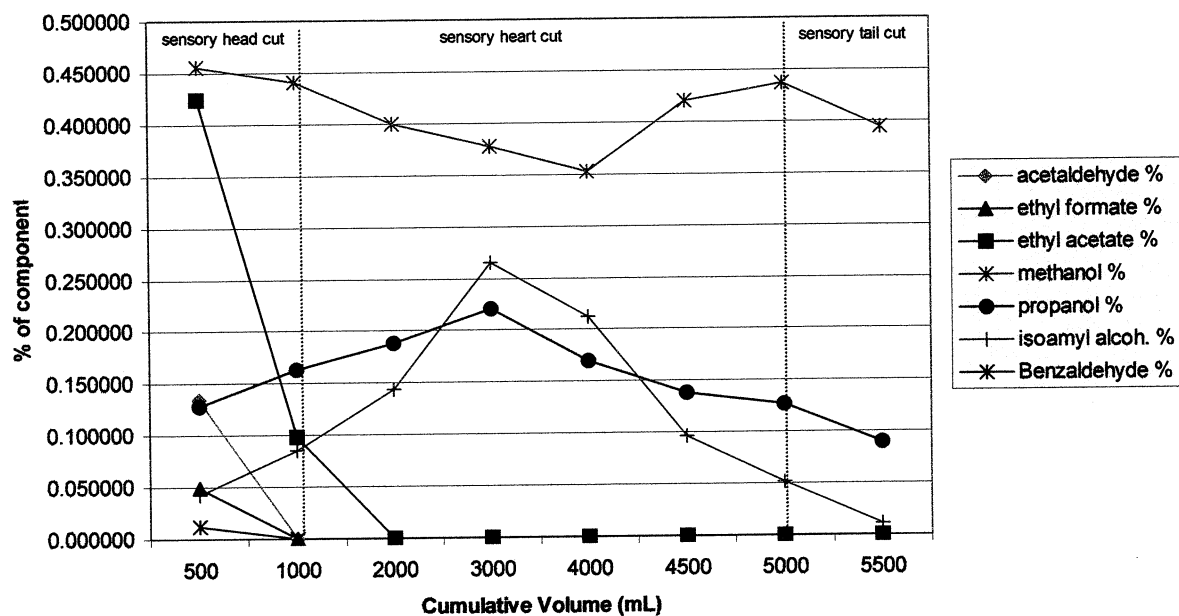


Figure 1. Schematic diagram of a Christian-Carl 120 L still ².

Crest Haven Peaches-Distilled Minimum Pits



Jonathon Apples

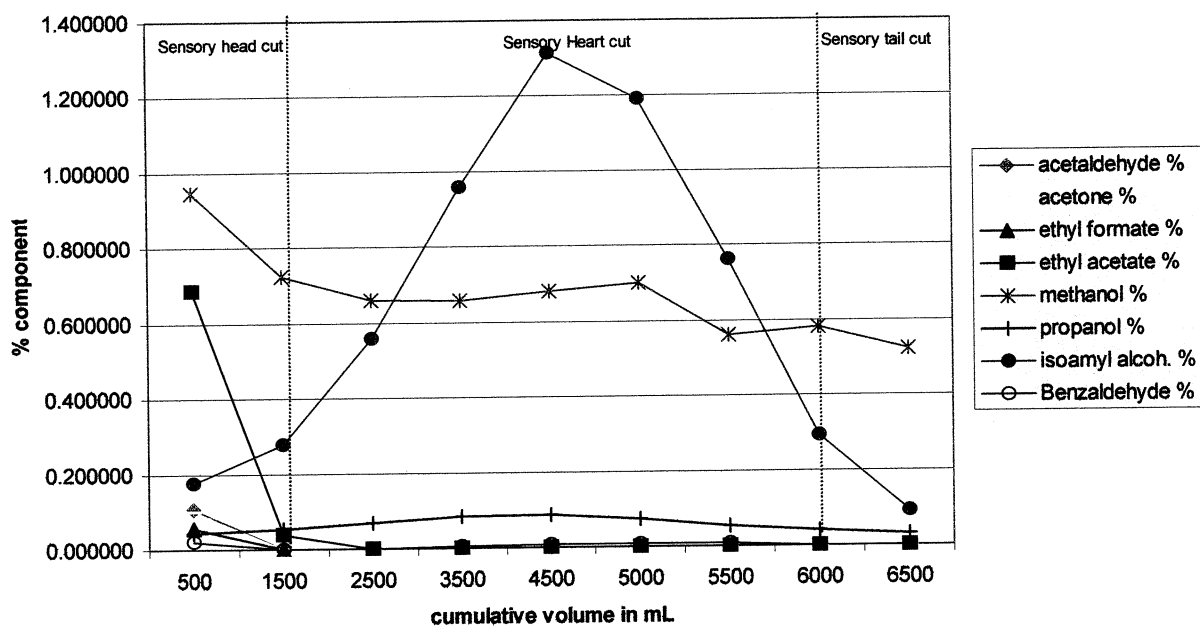


Figure 2. These two graphs are examples of the results from the GC analysis and where the cuts of head, heart, and tail were made using sensory at the time the product was collected.

<i>Components of distillates</i>	<i>Boiling Points °C at 760 mmHg</i>
Acetaldehyde	21
Acetone	56.5
Ethyl formate	53-54
Ethyl acetate	77
Methanol	64.7
Ethanol	78.5
n-propanol	97.2
isopentyl alcohol (isoamyl alcohol)	130.5
Benzaldehyde	179

Table 1. Components most commonly found in fruit distillates and their boiling points at normal pressure ⁴.

Table 2.1 GC Analysis of Peach Varieties

Sample #	cum vol ml	acetaldehyde %	acetone %	ethyl formate %	ethyl acetate %	methanol %	ethanol %	propanol %	isoamyl %	Benzaldehyde %
Red Haven NP 3.A										
4.A	500	0.119611	0.000000	0.000000	0.517827	0.898265	80.765587	0.092741	0.039004	0.000000
5.A	1500	0.000000	0.000000	0.000000	0.029172	0.911216	94.155333	0.128858	0.086961	0.000000
6.A	2500	0.000000	0.000000	0.000000	0.000000	0.802630	89.521923	0.150429	0.164707	0.000000
7.A	3500	0.000000	0.000000	0.000000	0.000000	0.732590	80.628407	0.156222	0.255092	0.000000
8.A	4500	0.000000	0.000000	0.000000	0.000000	0.721818	66.963417	0.112619	0.173895	0.000000
9.A	5500	0.000000	0.000000	0.000000	0.000000	0.697763	50.026503	0.053677	0.000000	0.000000
10.A	6000	0.000000	0.000000	0.000000	0.000000	0.774769	46.826543	0.042317	0.000000	0.000000
Crest Haven NP 10.A										
11.A	500	0.092886	0.000000	0.000000	0.386294	0.567691	85.233707	0.085079	0.000000	0.000000
12.A	1000	0.000000	0.000000	0.000000	0.066157	0.464893	88.016450	0.135551	0.016662	0.000000
13.A	2000	0.000000	0.000000	0.000000	0.000000	0.392197	89.667663	0.202962	0.111178	0.000000
14.A	3000	0.000000	0.000000	0.000000	0.000000	0.386894	82.291263	0.222041	0.267719	0.000000
15.A	4000	0.000000	0.000000	0.000000	0.000000	0.348290	55.162843	0.119197	0.154532	0.000000
16.A	4500	0.000000	0.000000	0.000000	0.000000	0.284412	35.474290	0.052349	0.000000	0.000000
17.A	5000	0.000000	0.000000	0.000000	0.000000	0.219285	25.448860	0.035065	0.000000	0.000000
Crest Haven DMP 24.A										
25.A	500	0.134213	0.000000	0.000000	0.424344	0.455910	80.447015	0.128039	0.042938	0.012298
26.A	1000	0.000000	0.000000	0.000000	0.098696	0.440242	87.762140	0.163069	0.085588	0.000000
27.A	2000	0.000000	0.000000	0.000000	0.000000	0.399722	86.080840	0.188327	0.144083	0.000000
28.A	3000	0.000000	0.000000	0.000000	0.000000	0.377962	84.269050	0.220428	0.265097	0.000000
29.A	4000	0.000000	0.000000	0.000000	0.000000	0.352968	68.521645	0.169330	0.212612	0.000000
30.A	4500	0.000000	0.000000	0.000000	0.000000	0.420456	69.765500	0.138582	0.096836	0.000000
31.A	5000	0.000000	0.000000	0.000000	0.000000	0.436803	70.549340	0.126872	0.052022	0.000000
Crest Red mix 32.A										
33.A	500	0.064898	0.000000	0.050520	0.175216	1.148125	86.479515	0.113010	0.065650	0.010300
34.A	1000	0.000000	0.000000	0.000000	0.000000	0.900443	81.806505	0.134047	0.130443	0.000000
35.A	2000	0.000000	0.000000	0.000000	0.000000	0.860669	79.256865	0.152848	0.220592	0.000000
36.A	3000	0.000000	0.000000	0.000000	0.000000	0.611416	44.208825	0.070954	0.053496	0.000000
Encore NP 44.A										
45.A	500	0.003185	0.000000	0.075075	0.408940	1.557760	93.286353	0.241653	0.016632	0.000000
46.A	1000	0.000000	0.000000	0.050503	0.066385	1.083820	81.852730	0.263429	0.037197	0.000000
47.A	1500	0.000000	0.000000	0.049112	0.000000	1.054015	84.377740	0.306729	0.068008	0.000000
48.A	2500	0.000000	0.000000	0.000000	0.000000	1.206431	91.240300	0.405023	0.152989	0.000000
49.A	3500	0.000000	0.000000	0.000000	0.000000	0.868625	76.194183	0.405928	0.243844	0.000000
50.A	4500	0.000000	0.000000	0.000000	0.000000	0.871419	65.610695	0.321648	0.209773	0.000000
Encore DMP 51.A										
52.A	500	0.000000	0.000000	0.064406	0.336034	1.065035	80.929535	0.266005	0.030041	0.000000
53.A	1000	0.000000	0.000000	0.051469	0.046018	0.944747	86.579070	0.393657	0.135122	0.000000
54.A	1500	0.000000	0.000000	0.048919	0.000000	0.756383	69.436540	0.329305	0.121594	0.000000
55.A	2500	0.000000	0.000000	0.000000	0.000000	0.945232	86.670863	0.442082	0.201921	0.000000
56.A	3500	0.000000	0.000000	0.000000	0.000000	0.940730	83.254880	0.439607	0.229779	0.000000
57.A	4500	0.000000	0.000000	0.000000	0.000000	1.040196	81.965805	0.384212	0.164261	0.000000
58.A	5000	0.000000	0.000000	0.000000	0.000000	0.881848	61.363655	0.232312	0.027651	0.000000
59.A	5500	0.000000	0.000000	0.000000	0.000000	0.783010	50.957450	0.170236	0.000000	0.000000

Table 2.2 GC Analysis for Apple Varieties

[illegible]

<i>Variety</i>	<i>Fruit Quality</i>	<i>°Brix</i>	<i>pH</i>	<i>%TA</i>	<i>Start % Ethanol</i>	<i>Vol. head cut (mL)</i>	<i>Vol. heart cut (mL)</i>	<i>% Ethanol at tail cut</i>	<i>Vol. tail cut (mL)</i>	<i>End % ethanol</i>
Red Haven - No Pit	Good	11.9	3.90	0.52	5.8	500	4000	57	500	50
Crest Haven – No Pit	Fair	13.4	3.65	0.70	5.8	1000	3000	63	1000	29
Crest Haven – Minimal Pits	Fair	13.2	3.71	0.65	5.8	1000	4000	66	500	58
Crest and Red Haven mixed	Poor	10.4	3.94	0.44	5.2	1000	2000	64	500	42
Encore – No Pit	Poor					1500	3500	66	1000	30
Encore – Minimal Pits	Poor					1500	4000	68	1000	25
Jonathon	Good	15.0	3.26	0.93	8.0	500	6000	60	1500	25
Gayla	Good	14.2	3.86	0.35	7.6	500	7000	50	2000	25
Red Delicious	Fair	13.0	4.07	0.22	5.2	500	4000	77	500	58
Ozark Gold	Good	13.0	3.62	0.39	6.8	500	5000	60	1000	30

Table 3. Pre and post-fermentation data and volume of each cut of distillate collected.